Arithmetical RECREATIONS:

OR,

ENCHIRIDION

OF

Arithmetical Queſtions:

Both Delightful and Profitable.

All of them performed without *ALGEBRA.*

1714

With ſeveral Arithmetical Problems and their Anſwers.

ALSO,

Divers ſubtile Contracts or Agreements. A Diſcourſe concerning the Harmony of Numbers, and variety of Compendiums in the ſeveral Rules of Arithmetick.

By *Will. Leybourn*, Philomathemat.

The Third Edition, Corrected, and very much enlarged by the Author.

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To the ingenious Student in the Science of Numbers.

IN the perusal of several Books, some of Vulgar, some of Decimal, and some of Algebraical Arithmetick: as also of Geometry, and other of the Sciences Mathematical; in the viewing and reading whereof, when I met with any Delightful Arithmetical Question, which to resolve, required more than the common Rules of Vulgar Arithmetick do afford; I noted them down, which (together with divers other, which at several times came into my thoughts) I have here heaped together and bound them up in this small Enchiridion, or handful of Numerical Recreations, for the delight and exercise of such Youths and others, as are studious of, and desire to be Proficients in the

Science of Numbers; *knowing, that by the practice and understanding the reason of these and such like Questions (which will not onely increase their knowledge in this Science, but recreate their spirits also) they shall with delight attain to a greater, and more than ordinary degree of knowledge in a short time, than by learning of* Arithmetick, *as (for the most part) it is taught in Schools, in many Weeks. For, by the practising and right understanding of the reason of the resolving any few of these Questions, he shall accumulate to himself more profit in this Science, than by sitting at School two or three dayes; nay, (it may be) some Weeks, Multiplying and Dividing a great number of Figures, which when he hath done, (to his great loss of time) he knows not what he hath done, nor, sometimes, the Master which putteth a Youth upon such labour, which is as unnecessary for a Youth, as it is toylsome in performance.*

But I speak not this, neither publish I this Manual, *to the end it should be the onely Study and Practice of Youth; or to deter their Parents from putting them*

to

to School to learn Arithmetick, which is a Jewel fit to adorn all ſorts and degrees of Men, from the higheſt to the loweſt: But as uſeful Recreations, at ſpare hours, for Boys at School, to oppoſe one another in; and at vacant times between their School-hours, to buſie and delight themſelves withal. For what is more pleaſing to Youth than Recreation? And what Recreation can be better make choice of, than that which will increaſe his knowledge?

We ſee by experience, that Man after Toyl & Labour deſireth Reſt, and after that returns again to his wonted employment, with the greater vigour and alacrity. And this is not experimentally true in Man only, but in other Creatures alſo, as may appar by that of the Poet.

A *Field* left fallow ſome few years, will yeild
The richer Crop, when it again is Til'd:
A *River* ſtopped by a Sluce a ſpace
Runs after rougher, and a ſwifter pace.
A *Bow* while unbent, will after caſt

Its Shafts the farther, and them fix more faſt.
A *Souldier* that a Seaſon ſtill hath lain,
Come with more fury to the Feild again.
Even ſo our *Body* while to gather breath,
From *Reſt* to *Pain* again it ſojourneth;
It recollects its Powers, and with cheer
Falls freſh again into its firſt career.

For this, and the fore-mentioned ends and purpoſes, I have collected theſe following Numerical Recreations; *in which, if thou takeſt as much delight in the Practice of them, as I have done in the Compoſure, thou ſhalt in the end find thy labour not loſt, or (when thou comeſt to years of diſcretion) think thy time not ill ſpent.*

The Queſtions are in number 60, *intermixed one with another, having no dependance or coherence, every one proving it ſelf without reference to any Rule in Vulgar* Arithmetick, *but the reaſon of each Proof is to the Eye viſible, in the operation it ſelf.*

I could have made the number of Queſtions greater, but it would have been to little purpoſe; for he that can work (and underſtand the reaſon of working) theſe, may vary & make theſe 60 amount unto 600.

Unto the forementioned 60 Queſtions, *I have added 15 other* Queſtions *by way of* Problem, *with their* Anſwers; *omitting the manner of the working of them, ſo that the ingenious* Practitioner *may exerciſe himſelf therein; which will give him ſufficient light, and confirm him in the reſolving of the like when they ſhall be propounded to him.*

After theſe Problems, *I have inſerted (by way of* Diſcourſe *only) ſeveral* Agreements *and* Contracts, *between Party and Party, ſeeming fair and reaſonable at their Propoſing, which the ſubtilty of* Numbers *diſcovers to be either* impoſſible *in the* Performance, *or* fallacious *in the* intent *of the party that offers them: All which are intermixed with other* pleaſant *and* profitable Diſcourſes *of ſeveral kinds. And herein alſo I have declared the* Subtilty, Propriety, *and ſecret* Harmony *that there is in ſome* Numbers, *both in* themſelves, *and being joyned with* others.

And in the last place, I have added divers compendious Rules *in* Arithmetick, *which will be of good use to such that have occasion to deal in the* Multiplying *and* Dividing *of great* Numbers, *& for other purposes also. I might have added more, but those were such that at the present came into my mind, and, I think they are such as are as* necessary, *as any other I could think upon; I am sure they are as* useful, *and especially to those whose Memories are not so quick and ready to* Multiply *and* Divide *as some others are.*

As I find these accepted, I shall be the more animated to enlarge them, as occasion shall offer it self; in the mean time, take this Treatise *as it is; peruse it, and* practice *it; and if thou find any thing therein to thy advantage, make good use of it, and thank the Editor.*

Vale.

Fare ever well, so ever wishes he,
Who is more thine, than he can seem to be.

Arith-

Arithmetical

RECREATIONS:

OR,

Enchiridion, &c.

QUEST. 1.

How to find the Number which any person shall think upon, be it never so great

BID the party which thinketh double his thought, and multiply that double by 5, and give you the sum or product of that Multiplication; from which sum or product, if you omit the last Figure thereof, which standeth towards your Right hand, (which will always be a Cypher) the remaining Figure or Figures shall be the number which the party thought upon.

Example.

Suppose the party should think upon 93, that doubled makes 186, which being multiplyed by 5, the product will be 930; from which sum if you omit the last Figure towards the Right

hand, (which is here a Cypher) the reſt will be 93, the number which the party thought upon.

But becauſe the laſt place being always a Cypher, may cauſe the other party which thinketh to conceive it eaſily, they being the very Figures which he thought remaining; it will be neceſſary (the more to obſcure the buſineſs) to bid him add to the laſt product ſome other Number, what you pleaſe, and then let him give you the ſum of all; from which, firſt ſubſtracting the Number you bid him add, and then omitting the laſt Figure or Cypher, the remainer then ſhall alſo be the number which the party thought at firſt.

Example.

Suppoſe a party ſhould think upon 197, this doubled will be 594, which being muitiplyed by 5, produceth 2970; to which (the more to evade the buſineſs) bid him add 131, or any other number, and then give you the ſum, which will then be 3101: from which number, if you privately ſubſtract the 131, which you bid him add, there will remain 2970, from which take the Cypher,

pher, and there will remain 297, the Number which the party firſt thought upon.

QUEST. 2.

If two, three, four, or five perſons ſhould each of them think upon a ſeveral Number, to tell what Number each perſon thought upon, provided that none of the perſons think above 9.

LEt the firſt party double the number he thought, and to that add 5, and that ſum multiply by 5, and to it add 10: If from this Number you privately ſubſtract 35, the firſt Figure of the remainder towards the Left hand ſhall be the Number that the firſt party thought upon.

Example.

If the party think ——— 7
That doubled makes ——— 14
To which add 5, makes ——— 19
This 19 multiplyed by 5, makes — 95
To which add 10, it is ——— 105

From this 105 take 35, there will remain 70, the firſt Figure whereof is 7, the Number thought. This

This you may do if one perſon only think: but if two, three, four or five perſons think, it will ſtill be the ſame.

Example.

Let three perſons, *William*, *James*, and *Thomas*, think theſe three Numbers, 4, 9 and 6.

William's Number is ——— 4
Which bid him double, it makes — 8
To which let him add 5, it makes--13
Which let him multiply by 5, it produceth ——— 65.
To this let him add 10, it makes--75
To this product let *James* privately add his Number ——— 9
It makes ——— 84
Which let him multiply by 10, it makes ——— 840
To this product let *Thomas* privately add his Number ——— 6
It makes ——— 846
Which let him multiply by 10, it makes ——— 8460.

This done, bid them give you this laſt product, which is 8460: from this product 8460, do you ſubſtract 3500, and there will remain 4960; the Cypher being omitted, there will be left 4,9,6, which

which were the three Numbers that the three parties thought.

Note, that if one party think, then you must take only 35 from the last product: if two parties think, take 350; if three parties, take 3500; and if four parties, 35000, &c.

QUEST. 3.

A more artificial way to find the Number that any person thinketh upon, without asking him any Questions

LEt the party that thinketh multiply the Number which he thought upon, by what Number he pleaseth; then bid him divide the product of that multiplication, by what other Number he pleaseth. Again, let him multiply this Quotient by what Number he pleaseth, and divide that Quotient again by what other Number he thinketh fit; and let him thus continue Multiplying and Dividing as many, or as few, times as he pleaseth, either 2, 3, 4 or 5 times more or less at pleasure [*Only so often as he Multiplies*

and

and Divides, let him tell you by what Numbers he multiplies and divides.] And when he hath Multiplied and Divided as often as he liſteth, bid him divide his laſt Number by the Number he thought upon, and keep the Quotient to himſelf.

In like manner do you take any Number at adventure, and privately Multiply and Divide it as often as he doth, and by the ſame number as he doth; and when you have done it as often as he hath done, and divided your laſt number by the number that you ſuppoſed, you ſhall find your laſt Quotient will be the ſame with his.

Then to know his number which he thought upon at firſt, bid him add his laſt Quotient to the Number which he thought upon, and give you the ſum; from which ſum ſubſtract your laſt Quotient, and the number which he thought upon will remain.

Example.

Suppoſe a party ſhould think upon—50
And multiply by it 4, it makes——200
And divide that product by 2, it makes——100

And

And multiply that Quotient again by 6, it makes ——— 600
And divide that again by 4, it makes ——— 150
And thus he may Multiply and Divide, again and again, if he pleaseth.
In the mean time, suppose you should privately think upon ——— 40
That multiplied by 4, maketh --- 160
And divided by 2, produceth -- 80
Which multiplied again by 6, giveth ——— 483
And divided by 4, produceth — 120

Here you see that his last Quotient is 150, which if he divide by 50, the number which he thought, the Quotient will be 3.

In like manner your last Quotient is 120, which if you divide by 40, (the number which you supposed) your Quotient will be also 3, equal to his.

Now bid him add his last Quotient to his number thought, and give you the sum, which is 53; from which if you substract your last Quotient 3, there will remain 50, the Number which he first thought upon.

Again, this being a very delightful and

and pleasant Question, wherein there is couched much of the subtilty of numbers, I will not let it pass with one Example, but give you another.

Let the party think ——— 25
And multiply it by 8, makes —— 200
Divide that by 4, gives —— —— 50
That he multiplies by 3, gives--- 150
And divides it by 5, gives —— 30

This 30 being divided by 25, his Number thought, giveth in the Quotient $1\frac{5}{25}$ or $1\frac{1}{5}$.

Now suppose you imagine —— 30
And multiply that by 8, it makes-240
And divide it by 4, it produceth 60
Which multiplied by 3, giveth-- 180
This divided by 5, gives —— —— 36

This 36 being divided by 30, your Number supposed, giveth in the Quotient $1\frac{6}{30}$ or $1\frac{1}{5}$ equal to his last Quotient.

Now if he add 25 his Number thought, to $1\frac{1}{5}$ his last Number, the Sum will be $26\frac{1}{5}$; from which if you take $1\frac{1}{5}$ your Quotient, there will remain 25, the Number which he thought.

QUEST.

QUEST. 4.

If a Pile of Counters, or other peices of Money, or other things, lie on a heap together; and three parties take out from them a certain number unknown to you; by knowing the ſum of them all, to find how many each party took.

BId one of the parties take from the Heap either 4, 8, 12, 32, 64, or any other number which may be divided by 4, and keep them to himſelf. Then ſay to the ſecond party, For every four peices that he hath, do you take ſeven peices: And let the third party for every four pieces that the firſt had, take 13 pieces: which when they have done, bid them put them all together, and give you the Sum, which do you divide privately by 3, the Quotient ſhall be double to the Number which the firſt party took.

Example.

Suppoſe the firſt party took 12, that is three times 4; then the ſecond perſon for every four muſt take 7, that is three times 7, or 21. Laſtly, The third

third perſon muſt take three times 13, that is 39 : Theſe three parcels being put together, make 72, which if you divide by 3, the Quotient will be 24, the half whereof is 12, the Number of Pieces that the firſt party took.

QUEST. 5.

Any Number of Counters, Stones, Eggs, or other things being laid in a row, to tell what Number any perſon, ſitting by, thinketh upon, provided the party think not a number greater than the number of Counters, Stones, Eggs, &c. which lie before him.

LEt the nine ● following repreſent nine Counters, or the like.

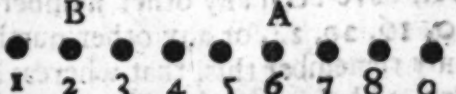
● ● ● ● ● ● ● ● ●

Do you (privately to your ſelf) call that which lieth next your Left-hand, One, the next Two, the third Three, &c. that then towards your right-hand will be 9. Then bid any Perſon think any Number under 9, & pitch his Finger upon which of the Counters he pleaſeth: then (you knowing privately

vately which Counter it is, whether the firſt, ſecond, third, or any other) add 9, privately to that number; as if the party ſhould lay his Finger upon the ſixth Counter, add 9 privately thereto, and it makes 15: therefore bid the party count to himſelf from that number which he thought, till he make it 15; and that Counter upon which the number 15 falleth, is the Number which the party thought upon.

Example.

Let the nine Counters lie as here you ſee.



Then ſuppoſe a party ſhould think upon 2, and that he ſhould pitch his finger upon the Counter noted with A, (which is the ſixth Counter.) Now (becauſe he pitched upon the ſixth Counter) add privately 9 to 6, and it will make 15: Wherefore, bid him count from the number which he thought upon (beginning at A backwards, till he come to 15) and his number will end at the Counter B, which

which is the ſecond Counter, denoting that he thought upon 2. For (being he thought upon 2) if he call the Counter A 2, the next Counter towards the Left-hand muſt be 3, the next 4, the next 5; and ſo the firſt Counter will be 7, then the laſt Counterwill be 8, and next to it 9; and ſo it will end at the Counter B, which is the ſecond Counter, and denotes his number thought upon to be 2. And here note, that whereas here are only 9 Counters placed, there might as well have been any other number, as 10, 16, 20, 24, or any other number; only remember this, that whereas here you added 9 to the Number of the Counters that the party pitched his Finger upon, you then add that number which is equal to the number of Counters lying before you; as if 10 then add 10; if 12, add 12; if 20 add 20, *&c.*

This is the way by which ſome will diſpoſe the ſeveral Spots of the Cards and lay them with the Face downwards in order of a Dyal, counting the Ace 1, the Duce 2, the Tray 3

&c.

&c. the Queen 11, and the King 12: by which they will undertake to tell what Hour you think upon; which is very pleaſant to practiſe, and ſeeming ſtrange to thoſe who know not the reaſon of it.

QUEST. 6.

One perſon having two Bottles of Wine, in each hand one, the one being Sack, and the other Claret, (or any other two things, as two peices of Money, &c. provided the one be even and the other odd) to find in which Hand the Bottle of Sack is, and in which the Claret; or in which Hand the odd, and in which the even peice of Money is.

LEt any perſon have in his hands two Bottles, one full of Sack, the other full of Claret; how to know in which hand he hath the Sack, and in which the Claret: to effect it, do thus:

Bid the party that hath the Bottles in his hands to double the price of the Wine which he hath in his Left-hand, and treble the price of that Wine which

which he hath in his Right-hand; then bid him add both Numbers together, and ask him whether it be even or odd: If it be even, the Sack (or even peice of Money) is in the Right-hand; but if it be odd, the Claret (or odd peice of Money) is in the Right-hand.

Example.

Let one have a Bottle of Sack (or 12 *d.*) in his Left-hand, and a Bottle of Claret (or 5 *d.*) in his Right-hand; he having thus disposed them unknown to you, bid him double the Money in his Right-hand, it is 24; then bid him treble the peice which is in his Left-hand, and it is 15; then bid him add them both together, and they make 39; for 24 and 15 is 39. This done, ask him whether the Number be even or odd. He will say, Odd. Then tell him he hath the Sack or 12 *d.* in his Left-hand, and the Claret or 5 *d.* in his Right.

Or if he had the Sack in his Left-hand, and the Claret in his right, and you had said, Double that in your Right-hand, it makes 10, and treble that

that in your Left, it makes 36; add them together, they make 46; it being even, denotes the Claret or odd number to be in the Right-hand. Wherefore obſerve this always:

you double the Right-hand, and the nnmber be even, the odd number is in the right. If you double the Right-hand, and the Number be odd, the even number is in the Right. If you treble the Right-hand, and the Number be even, the even number is in the right. If you treble the Right-hand, and the number be odd, the odd number is in the right.

This may be done by two parties, interchanging two pieces of Money, or by giving two perſons two Cards, one odd, the other even; and placing them before you, that you ſuppoſe one to be the Right-hand, and the other the Left.

QUEST. 7.

A man being 100 *years of Age upon his Birth-day had his three Sons with him at Dinner, namely,* William, James *and* Thomas: *the Father ſaying to them,*

them, Well Sons, I am this day just 100 years old; The Youngest, William, said, Father my Brother Thomas *is four times as old as I am, and my Brother* James *is three times as old as I am, and all our Ages together are just 100 years. How old was each of the three Sons?*

TO resolve this, say, *William* was one year old; then *James* must be three times his Age, that is, three years old; and *Thomas* must be four times his age, that is, four years old. Now all these added together make but eight years, whereas they should be 100 years: Wherefore, divide 100 by 8, and the Quotient will be 12½, that is, 12 years and an half for the Age of *William*. Then,

	Years.	Months.
William being	12	6
James must be 37		6 Three times as much, and
Thomas must be 50		0 Four times as much:
In all 100		0 Equal to the Fathers Age.

QUEST.

QUEST. 8.

A man dies, and leaves a Legacy of 900 *l. to be disposed of among four of his Relations,* viz. *A, B, C, and D; which Legacie is to be disposed of in this order: B is to have twice as much as A, and C thrice as much as B, and D is to have as much and half as much as C: What must each person have?*

TO effect this, or the like, suppose that A were to have 1 *l.* then B must have 2*l.* which is twice as much; and C must have 6*l.* which is three times as much as B; and D must have 9*l.* which is as much and half as much as C.

These Numbers added together make 18: divide 900 the whole Legacie, by 18, the Quotient will be 50*l.* for A, then B must have 100*l.* and C 300*l.* and D 450*l.* which all being added together, make 900 *l.* equal to the whole Legacie, and so disposed according to the Donor's Will, as by the work following may appear.

A	2	4	*l.*	A	50
B	2	900	(50	B	100
C	6	188		C	300
D	9	1		D	450
	18				900

QUEST. 9.

A man dies and leaves 3000 l. to be distributed to his Wife, his Son, and his two Daughters, in this wise; That the Son's Portion should be double to that of the Mother, and the Mothers Portion double to each of the Daughters. How much must each of their Portions be?

SUppose the Portion of one of the Daughters to be 1 *l.* then the Mothers portion must be double to one of the Daughters, (or equal to them both) namely 2 *l.* and the Son's Portion must be double to the Mothers, namely 4 *l.* These four Portions together make 8 *l.* (as in the Example is expresst) but they should be equal to 3000 *l.* wherefore divide 3000 by 8, and the Quotient will be 375 *l.* for one of the Daughters Portions. Then the Mothers is twice as much

much, namely 7 0 *l.* and the Son's double to that, namely 1500 *l.* All which is visible by the following Work.

	l.		*l.*
One Daughter ——	1		
The other Daughter-	1	64	
The Mother ——	2	30 0	375
The Son —— ——	4	888	

The Sum ——	8
One Daughter —— ——	375
The other Daughter ——	75
The Mother —— ——	750
The Son —— ——	1500
The Sum —— ——	3000

QUEST. 10.

There were in company together four persons Adam, Edward, Charles, *and* William. Adam *told* Edward *that he was older than him by two years:* Charles *told them that he was as old as both of them together, and four years over.* William *hearing them say so, said to them, I am just 96 years old, and that is equal to all your Ages. Now how old was* Adam, Edward *and* Charles *severally?*

SUppoſe *Edward* were 1 year old, then for *Edward*'s age put (1) then *Adam*'s age muſt be (1 more by 2); and *Charles* his age muſt be (2 more by 6): Thoſe three ages added together in this manner, as is here expreſſed:

Edward — 1
Adam — 1 more by 2
Charles — 2 more by 6

4 more by 8

This 4 more by 8 ſhould be equal to 96, *William*'s Age, had your Suppoſition been right; but being it is not, take 8 out of 96, and there will remain 88; which divide by 4, and the Quotient will be 22, which is *Edward*'s Age.—Then accordirg to the Queſtion, *Edward* being 22 years old, *Adam* muſt be 24 years old, which is as old as *Edward*, and 2 years more; then *Charles* muſt be 50 years old, which is as old as *Edward* and *Charles* together, and 4 years over. So their Ages added together, make 96 years, equal to *William*'s Age, as he appeareth.

Edward — 22

Ad

Adam —— 24
Charles —— 50

William's Age—96

QUEST. II.

Three perſons, Andrew, Benjamin, *and* Charles *are to go a Journey of* 235 *Miles; of this Journey,* Andrew *is to go a certain number of Miles unknown;* Benjamin *is to go four times as many miles as* Andrew, *and three miles more; and* Charles *is to go twice as many miles as* Benjamin, *and five miles more. How many Miles muſt each of theſe perſons travel ſeverally, to make out their Journey* 235 *Miles?*

SUppoſe that *Andrew* went onely one mile; then *Benjamin* muſt go four times as much, that is, 4 miles, and 3 over: Then *Charles* muſt go twice as much as *Benjamin* which is 8 miles, and 5 over. Theſe Numbers added together, as here you ſee, make but 13 Miles, and 8 over: Whereas the ſum of all their Journey ſhould be 235 miles.

Andrew travelled 1 mile.
Benjamin travelled 4 miles, and 3 over.
Charles travelled 8 Miles, and 5 over.

The Sum —— 13 miles, and 8. over.

Wherefore, becauſe your Suppoſition was not right, ſubſtract the 8 over-miles from 235, (the number of Miles they were to go in all) and the remainder will be 227: divide 227 by 13, and the Quotient will be $17\frac{6}{13}$; ſo that *Andrew* for his ſhare muſt travel 17 miles, and $\frac{6}{13}$ of a Mile. And *Benjamin* muſt travel 4 times as much, which is $68\frac{24}{13}$, and 3 miles more. And *Charles* muſt go twice as far as he, which is $136\frac{48}{13}$ and 5 miles more. All which being added together, will make 235 miles; as you may here ſee.

Andrew muſt go —	$17\frac{6}{13}$	
Benjamin —	$68\frac{24}{13}$	more 3
Charles —	$136\frac{48}{13}$	more 5
The Sum —	$221\frac{78}{13}$	more 8

Here the Sum is 221 Miles, and $\frac{78}{13}$, which makes juſt 6 Miles, and the 8 Miles more makes 235, which anſwers the Queſtion.

QUEST.

QUEST. 12.

The Captain, Lieutenant, and Cornet of a Troop have taken among them from ſome Enemy 478 Crowns, which they agree to ſhare in this manner: The Captain is to have 24 times as much as the Cornet, wanting only 7 Crowns; and the Lieutenant is to have 5 times as much as the Cornet, wanting 3 Crowns. I demand how much the Cornet muſt have, and conſequently the Lieutenant, and Captain?

IMagine the Cornet to have onely 1 ſhare, it matters not what: then the Lieutenant muſt have 5 ſhares, wanting 3 Crowns; and the Captain muſt have 24 ſhares, wanting 7 Crowns: Add all theſe ſhares together, as here you ſee.

The Cornet 1 ſhare.
The Lieutenant 5 ſhares wanting 3 Crowns.
The Captain 24 ſhares wanting 7 Crowns.

The Sum is 30 ſhares wanting 10 Crowns.

This 30 ſhares wanting 10 Crowns

ſhould be equal to 478: but being it is not, add the 10 Crowns to 478, and it makes 488; which divide by 30 (the Sum of the ſhares) and the Quotient will be $16\frac{8}{30}$, or $\frac{4}{15}$, which is the Cornet's ſhare. Then the Lieutenant's will be $77\frac{20}{15}$, which is 5 times as much as the Cornet's, wanting 3 Crowns; and the Captain muſt have $377\frac{26}{15}$, which is 24 times the Cornet's ſhare, wanting 7 Crowns: And theſe three Sums added together, make $470\frac{120}{15}$; as in the Example.

The Cornet	$16\frac{4}{15}$
The Lieutenant	$77\frac{20}{15}$
The Captain	$377\frac{26}{15}$
The Sum	$470\frac{120}{15}$

The Fractions make up 8 ſhares, (which you may find by dividing 120 by 15) which 8 being added to 470, maketh 478; the juſt Sum to be ſhared.

QUEST. 13.

A Drover driving of ſheep, one meets him, ſays, Good ſpeed friend with thy 20 Sheep. Nay, ſays the Drover, I have not 20 Sheep; but had I as many more, and half as many more, and two Sheep,

Sheep, and half a Sheep; then I should have 20 Sheep. How many Sheep had he in his Drove?

SUppose he had 1 Sheep, then as many more is 1, and half as many more is half a Sheep; that is 2 and an half; and 2 Sheep and an half more: add these together, thus:

1 Sheep.
1 as many more.
½ half as many more.
more 2½ Sheep.

The Sum 2½ more by 2½.

This 2½ more by 2½ should be equal to 20, but it is too little, wherefore take 2½ from 20, and there will remain 17½, which 17½ being divided by 2½, produceth for the Quotient 7: wherefore he must have 7 Sheep in his Drove.

7 Sheep.
7 as many more.
3½ half as many more.
more 2½ Sheep.
17½ more 17½ is equal to 20, which was required.

QUEST. 14.

There is 273 l. *to be divided amongst* 4 *persons*; *namely*, Andrew, Bennet, Christopher, *and* Daniel. Andrew *is to have a share unknown*: Bennet *is to have twice as much as* Andrew, *and* 30 *l. more*: Christopher *is to have* 3 *times as much as* Andrew, *wanting* 52 l. *And* Daniel *is to have* 5 *times as much as* Andrew, *and* 20 l. *more. How must this* 273 l. *be divided amongst them, that every one have his true share?*

Share

Suppose *Andrew* to have 1 for his part.

Then *Bennet* must have 2, and 30 *l.* over.

And *Christopher* must have 3, lack 52 *l.*

And *Daniel* must have 5, and 20 *l.* over.

The sum of the Shares is 11, lack 2 *l.*

The reason why I say 11 *shares wanting* 2 l. *is, because* Bennet *and* Daniel *together have* 50 *l. over, and* Christopher *wants* 50 l. *of* 3 *shares: therefore take their* 50 l. *from his* 52 l. *and there wants only* 2 l.

These 11 shares wanting 2 *l.* (by the

the tenor of the Question, should be equal to 273: but because 2 *l.* is wanting of eleven shares, therefore add 2 *l.* to 273 *l.* and it will be 275 *l.* which these 11 shares should be equal to; but being it is not, therefore divide 275 by 11, and the Quotient will be 25 *l.* for *Andrew*'s share. Then,

	l.
Andrew's share being	25
Bennet's must be as much more, which is 50 *l.* and 30 *l.* more, in all	80
And *Christopher*'s share must be three times as much as *Andrew*'s, that is 75 *l.* wanting 52 *l.* that is	23
And *Daniel*'s must be 5 times *Andrew*'s, which is 125 *l.* and 20 *l.* more in all	145
The Sum of the shares	273

Which is equal to the sum to be divided, and is divided according to every punctilio of the Question.

QUEST.

QUEST. 15.

A Master agrees with a Servant to work with him 30 days, agreeing to give him for every day that he wrought 7 s. and for every day that he idled, the Servant was to abate 5 s. At the expiration of the 30 days, they come to an account, that the Master and Servant were both even, neither to receive any thing. How many days did the Servant work? and how many did he play?

SUppose 1 Day for the days he laboured, comes to ——— 7 s.
Then he idled 29 days, which comes to ——— 145 s.

Now (because the Money that his labour came to, and the Money that he lost by neglect, came to the same) therefore add 5 s. (which he was to allow every day he neglected) to both the above-supposed Numbers, and they make 12 and 150: therefore divide 150 by 12, and you shall have in the Quotient 12½, and so many days he laboured; which being substracted from 30, the whole Number of days, there remains 17½, for the days he idled: for 12 days and a half, at 7 s. a day,

day, comes to 4 *l.* — 7 *s.* — 6 *d.* also 17 days and an half which he idled, at 5 *s.* a day, comes to the same sum; which declares the work to be true.

QUEST. 16.

A Dog is pursuing of a Hare, which is 100 *yards before him; and for every yard that the Hare runs, the Dog runs two yards and an half (that is, the Dog runs two times and an half swifter than the Hare.) I would know how many yards the Hare hath run when the Dog overtaketh her?*

PUt for the Yards (1 Y) (or any other Mark or Letter;) therefore the yards are (100 more 1 Y,) and because the Dog runs twice and an half faster than the Hare, take any two numbers in like proportion as 2½ is to 2; which will be 5 and 2, (for 1 doubled makes 2, and 2½ doubled makes 5:) these numbers thus found, there is the same proportion between (100 more 1 Y) to (1 Y) as there is between 5 and 2: Wherefore multiply (100 more 1 Y) by 2, the product is (200 more 2 Y) which is equal to

(1

(1 Y and 5 :) wherefore, if you ſubſtract 2 from 5, there will remain 3; and divide 200 by 3, the Quotient will be $66\frac{2}{3}$. Therefore I ſay, that the Hare will have run 66 yards and $\frac{2}{3}$ of a yard (which is 2 foot) when the Dog ſhall have overtaken her, and the Dog will have run $166\frac{2}{3}$ yards, which is twice and an half more than the Hare: for twice $66\frac{2}{3}$, and $33\frac{1}{3}$, which is half $66\frac{2}{3}$, is equal to $166\frac{2}{3}$, the quantity that the Dog ran.

QUEST. 17.

There are two Meſſengers ſet out from two Towns, which are 140 miles aſunder, upon one and the ſame day: The one travels 8 miles a day, and the other 6 miles. I demand how many days it will be ere they meet together.

PUt one D (or day) for the time they ſhall meet; in which time the one would have travelled but 8 miles of the Journey, and the other but 6 miles; theſe added together, make but 14 miles; whereas they ſhould have travelled 140 miles: Divide therefore 140 by 14, and the Quotient

tient will be 10; ſo that in 10 days they will meet together: which may thus be proved.

He that travels 8 miles a day, will in 10 days have travelled 10 times 8 miles, that is 80 miles. And

He that travels but 6 miles a day, will in 10 days travel 6 times 10 miles, that is 60 miles.

Theſe two Numbers, 60 and 80, being added together, make 140 miles, equal to the diſtance of the two Towns.

QUEST. 18.

A Foot-man goes a Journey, undertaking to go every day 9 miles: when he had been gone 10 days, more expedition was required, and a Horſe-man is ſent after him. How many miles in a day muſt the Horſe-man ride to overtake the Foot-man in 18 days?

FOr the miles that the Horſe-man is to ride, ſuppoſe one part of the Journey, (or 1 M:) therefore in 18 days he would have travelled 18 M. Now for that the Foot-man travelling every day 9 miles, he went in 18 days

162 miles; to the which add 90 miles, which he went in the 10 days that he ſet out before the Horſe-man, and the ſum is 252 miles. Now if you divide 252 by 18 M, you ſhall have in the Quotient 14: And ſo many miles muſt the Horſe-man travel in a day, to overtake the Foot-man in 18 days. — For if you multiply 18 by 14, the product will be 252, equal to the miles the Foot-man travelled in 28 days.

QUEST. 19.

One buys 100 Turkeys for 17 pound, in the ſelling of which again, he loſeth 18 pound in his laying out of his 102 pound. I would know how many Turkeys he ſold for one pound.

IMagine that he ſold one Turkey for one pound: then work by the Rule of Three, thus:

If 17 *l.* buy 100 Turkeys, how many will 102 *l.* buy?

Multiply 102 by 100, & the product will be 10200; which divide by 17, and the Quotient will be 600.

Then ſay again by the Rule of Three:

As

As 1 *l.* is to 1 T. ſo is 102 *l.* wanting 18 *l.* which he loſt, that is 84 *l.* to 84.

Here the determination of the Queſtion will be between 600, the firſt Quotient, and 84 the laſt Quotient.

Divide therefore 600 by 84, and the Quotient will be $7\frac{1}{7}$ T: and ſo many Turkeys he ſold for one pound.

It may thus be proved by the converſe working: For,

If $7\frac{1}{7}$ Turkeys coſt 1 *l.* what will 600 Turkeys coſt? Multiply and divide, you will find 84 *l.* which is 18 *l.* leſs than 102 *l.* which he laid out.

QUEST. 20.

One bought 8 yards of two ſorts of Stuff, as Calico, and Tammy, for 20 s. the Tammy coſt 4 s. a yard, and the Calico 2 s. How many yards did he buy of each ſort?

TO anſwer this, or the like Queſtion, multiply 8 (the whole Number of yards) by 2 (the leaſt price) it produceth 16; which ſubſtract from 20 (the whole price) the remainder will be 4: which divide by 2, (the difference of the price;) and the Quotient will

will be 2 for the number of yards of Tammy. and then there must be 6 yards of Calico. For,

2 Yards of Tammy at 4*s.* is ——— 8*s.*

And 6 Yards of Calico at 2*s.* is ——— 12*s.*

In all ——— 20*s.*

QUEST 21.

There are four sorts of Money, of which of one sort 7 peices makes a pound Sterling: Of the second sort, 18 peices makes a pound: Of the third sort 21 peices makes a pound: And of the fourth sort, 28 peices makes a pound. Of each of these pieces, a Merchant received in exchange a like number, all of them making 568 pound Sterling. I demand how many peices there were in all? and how much money he had of each several peice?

PUt (or imagine) 1 P, for the quantity of each several sort of Money. Now because to a pound Sterling there went 7 peices of the first, apply your self to the Rule of Three, in this manner, saying, If

If 7 peices of Money be worth 1 P
If 7 P be worth 1 *l.* what is 1 P worth? The anſwer will be, $\frac{1}{7}$ of a pound. Then again,

If 18 P be worth 1 *l.* what is 1 P worth? Anſwer, $\frac{1}{18}$ of a pound. Again for the third ſort,

If 21 P be worth 1 *l.* what 1 P? Anſwer, $\frac{1}{21}$ of a pound.

Laſtly, If 28 P be worth 1 *l.* what is 1 P? Anſwer, $\frac{1}{28}$ of a pound.

Now theſe Fractions do make together $\frac{337}{252}$, which ſhould be equal to 568. But ſeeing it is not, divide therefore 568 by $\frac{337}{252}$, and you ſhall find 2016, which is the value of 1 P: and ſo many of each of the peices he was to receive, to make up his ſum of 568 *l* Sterling; which may be eaſily thus proved.

	S
If 7 peices are worth	8
What are 2016 worth?	28
If 18 peices are worth	1
What are 2016 worth?	112
If 21 peices are worth	1
What are 216 worth	96
If 28 peices are worth	1
What are 2016 worth?	71

Here

Here you see that *l.*
2016 of the first peices make — 288
As many of the second ——— 112
As many of the third —— —— 96
And as many of the last —— —— 72

Which added together, make - 568
Equal to the Money changed; and so is the Question answered.

QUEST. 22.

There is an Army, whose Foot are 8 *times the number of the Horse: Amongst them there is* 392000 *Dollars to be distributed; so that each Horse-man is to have* 16 *Dollars, and each Foot Souldier* 5 *Dollars. I demand, Of how many Horse and how many Foot the whole Army consisted?*

IMagine the Horse-men to be one, or (1 H.)

And the Foot to be eight, or (8 F) because they are (according to the Question) to be 8 times as many as the Horse. Now (because each Horse-man is to have 16 Dollars) multiply 16 by 1 H, and it makes 16 H: Likewise, because each Foot-man is to have

5

5 Dollars, multiply 5 by 8 F, and it makes 40 F: add 16 H and 40 F together they make 56, which ſhould be equal to 392000 Dollers; but being it is not, divide 392000 by 56, and the Quotient will be 7000, for the number of Horſe men; and that multiplied by 8, giveth 56000, for the number of Foot.

Now if you multiply 7000 by 16, the product will be 112000, for the number of Dollars to be diſtributed to the Horſe-men, and multiplying 56000 by 5 the product will 28000 for the number of Dollars that the Foot men are to have; and theſe two added together, make 392000 equal to the number of Dollars to be diſtributed, and anſwers the Queſtion in all its particulars.

QUEST. 23.

An Hegler goes to a Country-Market and buys 100 *Eggs*, (*which is* 120) *after the rate of* 3 *for a penny. At another Market he buys* 120 *more at the rate of* 2 *for a penny; theſe Eggs he mingles together, and ſells his* 240 *Eggs at another Market, after the rate of* 5 *Eggs for*

for two-pence. I demand, whether he loſt, gain'd, or ſaved by this Bargain.

ACcording to common acceptation, any perſon unacquainted with Arithmetick, would conclude, that (beſides his Journeying from Market to Market) he loſt nothing, nor gained nothing. But by Arithmetical proof, you ſhall find that he loſt not only his Travel, but Money alſo.

For, by the common Rule of Three, you ſhall find, That if 3 Eggs coſt one penny, 120 will coſt 3 *s.*–4 *d.* for divide 120 Eggs by 3 Eggs, and there will be in the Quotient 40 pence, which is 3 *s.*–4 *d.*

Likewiſe, by the ſame Rule, you ſhall find, That 120 Eggs at 2 for a penny, will come to 5 *s.* for divide 120 by 2, and the Quotient will be 60 pence, or 5 *s.*

So that theſe two ſums, *viz.* 3 *s.* and 4 *d.* and 5 *s.* do make together 8 *s.* and 4 *d.* and ſo much did his 240 Eggs coſt him at both Markets.

But now to ſee whether he gained or loſt: Say by the ſame Rule of Three. If 5 Eggs coſt 2 pence, what ſhall 240 coſt? Mul-

Multiply 240 by 2, it produceth 480 which divide by 5, and in the Quotient you ſhall find 96 pence, which is but 8 ſhillings: ſo that beſides all his Travel, he loſt 4 pence in Money.

QUEST. 24.

One comes to a Draper, and demands the price of a yard of Canvas: the Draper demands 12 d. *Says the Chapman, I will willingly give you two ſhillings for every yard I buy of you: provided, that every Angel of my Money may go for twenty ſhillings: To which the Draper Aſſents.*

THis is rather a Fallacy than any thing elſe; but I have here inſerted it, to ſhew the cunning reach of ſome perſons, over the honeſt meaning of others.

The Draper and Chapman having thus agreed, the Chapman bids the Draper cut him off 5 yards, which at 2 *s.* the yard, comes to 10 *s.* The Chapman throws him down an Angel, (which by their agreement was to go for twenty ſhillings) and demands the reſt

reſt again, which was ten ſhillings. So that by this reaching trick, he would have had his 5 yards of Canvas of the draper for nothing.

QUEST. 25.

There are 100 *Stones which lie* 3 *foot or one yard upon the ground one from the other; and there is one employed to gather up theſe Stones one by one, and bring them to a Basket which ſtandeth* 3 *foot from the firſt Stone. How many yards of ground muſt he go backward and forwards in all, before he have brought the laſt Stone to the Basket?*

THE number of Stones being 100 and the Basket ſtanding one yard forward of the firſt Stone, makes in all 100 yards in length: wherefore to effect this,—— Add 1 to the number of yards, it makes 101; which multiply by half the number of yards, which are 50, the product will be 5050 which ſhews that he muſt go forward 5050 yards: then muſt he go backwards as much, which is ten thouſand one hundred yards; which is 5 miles and three quarters, wanting only 2 yards.

QUEST.

QUEST. 26.
The Fiſher-Man's Queſtion.

I caught a Fiſh (*others among*)
Whoſe Head *was full five foot long,*
And his Tail *was* (*truly*)
As long as his Head *and half his* Body,
And his Body (*without fail*)
Was juſt as long as his head *and* tail,
This is my Queſtion,
Reſolve it who can;
How long was the Body,
And Fiſhes Tail *than?*

MUltiply the length of the Fiſh's Head by 3, by 4, and by 8; the one product ſhall be the length of the Tail, the other the length of the Body; and the third, ſhall be the length of the whole Fiſh.

So the Head being 5 foot, this multiplied by 3, giveth 15 for the length of the Tail.

Again, Multiply 5 by 4, it produceth 20, for the length of the Body.

And laſtly, Multiply 5 by 8, it produceth 40, for the length of the whole Fiſh; and exactly anſwers the *Queſtion* in all its particulars.

For the Head being 5 foot, and the Tail 15 foot, and the Body 20 foot;

The Tail 15 foot, is equal to the whole Head 5 foot, and half the Body 10 foot: for 5 and 10 is 15.

Add the Body 20 foot, is equal to 15 foot the Tail and 5 foot the Head.

And theſe together make 40 foot, the length of the whole Fiſh.

QUEST. 27.

There is a Steeple, the top whereof caſteth its ſhadow upon the ground 260 foot from the bottom thereof: At the ſame time as you meaſure the ſhadow, the length of the ſhadow of your two-foot Rule is 3 foot: I demand how high this Steeple is.

THis Queſtion is eaſily anſwered by the Rule of Three: But I here inſert it with ſome others, to ſhew how ſerviceable Numbers, and the right underſtanding of them, are applicable to all ſorts of men and things. To effect this, this is the proportion.

As the length of the ſhadow of your Rule 3 foot, is to the length thereof 2 foot:

So

So is the length of the ſhadow of the Steeple 260 foot, to the height of the Steeple $86\frac{1}{3}$.

Wherefore, multiply 260 foot, the length of the ſhadow of the Steeple, by 2 foot, the length of your Rule, and the product is 520 foot; which divide by 3, the length of the ſhadow of your Rule, and the Quotient will be $86\frac{2}{3}$, that is, 86 foot and two third parts of a foot, which is 8 inches; ſo that the Steeple is 86 foot and 8 inches high.

QUEST. 28.

There is a Fountain which hath 4 Streams: in the Ciſtern whereof there is contained 8 barrels of Water; if the leaſt of the ſtreams be only opened, the Water will be 6 hours in running out: if the ſecond, it will be 4 hours running out: If the third be opened, it will be 3 hours running out: and if the fourth and greateſt be ſet running, it will run the Water out in 2 hours. I would know in what time all the Water would run out if all the 4 ſtreams were ſet running together?

BEcauſe the leaſt Stream will vent all the Water in 6 hours, it muſt therefore vent 8 Barrels in 6 hours; and the ſecond Stream would run 12 Barrels, the third 16 Barrels, and the biggeſt 24 Barrels.

Leaſt Stream	8
Second	12
Third	16
Biggeſt	24
In all	60

Then ſay by the Rule of Three,

If 60 require 6, what will 8 require?

Multiply 6 by 8, it produceth 48, which ſhould be divided by 60; but it being above 48, it is therefore $\frac{48}{60}$ or $\frac{4}{5}$ of an hour.

And in that time will all the Water run out of the Fountain, if all the 4 Streams were ſet running together.

QUEST. 29.

A man dying, leaves his Wife with Child of her firſt; and by Will bequeathed his Eſtate, which amounted to 2000 l. conditionally thus, That if the Child his Wife

Wife went withal were a Woman-kind, that then his Wife ſhould have two thirds thereof and the Child the other third: But if ſhe ſhould be delivered of a man-Child, then the Child was to have two thirds, and his Wife the other third. But after the Deceaſe of the Father, the Mother was delivered of two Sons and a Daughter. In what Nature ſhall this Eſtate be parted amongſt them, according to the Teſtator's will?

IT is evident, by the Will of the Deceaſed, that for every Third that the Daughter was to have, the Mother was to have two Thirds: And that the Son was to have double to the Mother.

Obſerving this order; if you allow to the Daughter 1 *l.* then the Mother muſt have 2 *l.* and either of the Sons muſt have twice as much as the Mother, that is 4 *l.* a peice. Wherefore for the two Sons put down 4 *l.* and 4 *l.* for the Mother 2 *l.* and for the Daughter 1 *l.* in this order:

	l.
The two Sons	4
	4
The Mother ——	2
The Daughter ——	1
The Sum —	11

Then ſay by the Rule of Three direct, If 11 *l.* the Sum of all the portions requires 2600 *l.* what ſhall 4 *l.* (which is one of the Sons ſhares) require?

Multiply 2600 by 4, the product will be 10400, which divided by 11, the Quotient will be 945 *l.* $\frac{5}{11}$, for one of the Sons ſhares: So then the other Son muſt have as much; and the Mother half as much; namely, 472 $\frac{8}{11}$: and the Daughter muſt have half as much as the Mother, namely, 236 $\frac{4}{11}$; all which being added together, make 2600 *l.* equal to the whole Eſtate; and anſwers the Will of the Teſtator in all particulars.

The two Sons	945 $\frac{5}{11}$
	945 $\frac{5}{11}$
The Mother ——	472 $\frac{8}{11}$
The Daughter ---	236 $\frac{4}{11}$
	2600 $\frac{22}{11}$

QUET,

QUEST. 30.

The Grand Father, the Father, and the Son met together, and ſpent 20 s. *When the Reckoning came to be paid, the Grand-father would pay one Half, the Father one Third, and the Son one Quarter. How much muſt every one pay of this Reckoning?*

TO reſolve this, If the Grand-father ſhould pay $\frac{1}{2}$, which is 10 *s.* and the Father $\frac{1}{3}$, which is 6 *s.* 8 *d.* and the Son $\frac{1}{4}$, which is 5 *s.* the Reckoning would be over paid: for theſe three added to gether, make 21 *s.* 8 *d.* and they ſhould pay but 20 *s.*

Wherefore you muſt work otherwiſe; as thus: Reduce $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, into one denomination, by multiplying the denominators one into another; ſaying, 2 times 3 is 6, and 4 times 6 is 24, which 24 is a new denominator. Then the $\frac{1}{2}$ of 24 is 12: and $\frac{1}{3}$ of 24 is 8: and $\frac{1}{4}$ of 24 is 6; the ſum of them is 26.—— And this 26 is your firſt number in the Rule of Three:——20 *s.* (which they ſpend) muſt be the ſecond number;---And 12 8, and

6 must be the three third Numbers:

——Wherefore say,

I. *If* 26 *pay* 20 s. *what must* 12 *pay?*

Multiply 20 by 12, it produceth 240; this divided by 26, giveth in the Quotient 9 s. $\frac{6}{26}$ for the Grandfather's part.

II. *If* 26 *pay* 20 s. *what must* 8 *pay?*

Multiply 20 by 8, the product is 160; which divide by 26, and the Quotient will be 6 s. $\frac{6}{26}$: and so much must the Father pay.

III. *If* 26 *pay* 20 s. *what must* 6 *pay?*

Multiply 20 by 6, it giveth 120; which divided by 26, gives in the Quotient 4 s. $\frac{16}{26}$: and so much must the Son pay.

	s.	d.	q.	
The Grand-father must pay 9 $\frac{6}{26}$,				
Equal to	9	2	3	
The Father must pay				6 $\frac{8}{26}$
Equal to	6	1	3	
The Son must pay				4 $\frac{16}{26}$
Equal to	4	7	2	
In all	20	0	0	

QUEST.

QUEST. 31.

There are four Cities or Towns lying one from the other in a right Line; and the two farthermoſt are diſtant one from the other 56 miles: and the diſtance from the third to the fourth, is as much as from the firſt to the ſecond, with half as much as between the ſecond and the third: And the diſtance between the ſecond and third is as much as the diſtance between the firſt and the ſecond, with the third and fourth together. How far were each of the Towns diſtant one from the other?

LEt the Four Cities or Towns be A B C D.

A 7 B 28 C 21 D

1——2——3——4

Becauſe the diſtance between the Third and Fourth, with the diſtance between the Firſt and Second, is equal to the diſtance between the Second and Third: Therefore divide 56 (the whole diſtance) by 8, and the Quotient will be 7; wherefore the diſtance between the firſt and ſecond Towns is 7 miles.

Again, it is evident, that the diſtance between the third and fourth muſt be three times as far, that is 21 miles. And the diſtance between the ſecond and third being equal to both them, muſt be 28 miles.

So is C D diſtant as far as A B and half B C.

And B C is diſtant as far as A B and C D together.

And A D is diſtant 56 miles.

QUEST. 32.

Two Ships *ſet ſail at one time; the one ſails directly East, 74 Leagues: The other ſails directly North, 62 Leagues: I would know how many Leagues theſe two* Ships *are aſunder.*

Multiply 74 by 74, and the product will be---	5476
Alſo Muultiply 62 by 62, the product is ———	3844
Theſe two Numbers added together, make ———	9320

Of this Nnmber 9320, extract the ſquare Root, and you ſhall find it to be almoſt 67: And ſo many Leagues are the two Ships aſunder.

QUEST.

QUEST. 33.

There was a May-pole, which in a windy night was broken, ſo that the top thereof lit upon the ground 30 foot diſtant from the bottom thereof; and the peice which was broken off was 50 foot long: At what length was the May-pole broken off, and how high was it in all?

MUltiply 50 (the length of the peice broken off) in it ſelf: that is, Multiply 50 by 50, it makes 2500. Likewiſe multiply 30 (the diſtance which it fell from the bottom) by 30, the product is 900; ſubſtract 900 from 2500, and there remains 1600: Extract the ſquare Root of 1600, and you will find it to be 40; ſo that there is 40 foot of the May pole ſtanding; and 50 being broken off, makes 90; ſo that the May-pole was 90 foot high.

QUEST. 34.

There is 16 l. to be diſtributed amongſt a number of poor people; ſome are to have Shillings, ſome ſix pences, ſome Groats, and ſome three-pences: How many poor People will this relieve, ſo that

that the number of those that receive Shillings, Six-pences, Groats, and Three-pences, shall be equal?

TO effect this, reduce the 160 *l.* into pence; it maketh 38400 pence for your dividend. Then add 12 *d.* 6 *d.* 4 *d.* and 3 *d.* together, they make 25 *d.* and this is your Divisor.

Then divide 38400 (the pence in 160 *l.*) by 25 (the sum of the shares) and in the Quotient you shall find 1536; and so many poor People must there be of a sort; which you may easily thus prove: For,

			l.	*s.*	*d.*
1536	Shillings	is	76	16	0
	Six-pences		38	08	0
	Groats		25	12	0
	Three-pences		19	04	0
	In all		160	00	0

Now if you would know how many Poor there were in all, multiply 1536 by 4, and the Quotient will be 6144; and so many poor People must there be in all to receive this Legacy.

QUEST.

QUEST. 35.

How many persons will there be required to receive 2880 Pence, some receiving 6 d. some 5 d. some 4 d. some 3 d. some 2 d. some 1 d. there being a like number of each sort?

IF you add 6 *d.* 5 *d.* 4 *d.* 3 *d.* 2 *d.* and 1 *d.* together, they make 21 *d.* by which, if you divide 2880, the Quotient will be $137\frac{3}{7}$; and so many persons must there be of a kind: which is thus proved:

For,		*l.*	*s.*	*d.*
137	Six-pences	3	8	6
	Five-pences	2	17	1
	Groats	2	5	8
	Three-pences	1	14	3
	Two-pences	1	2	10
	Pence	0	11	5
	In all	11	19	9

This 11 *l.*–19 *s.*–9 *d.* should have been 12 *l.* equal to 2880 pence; but by the former work you see that when you divide 2880 by 21, there remained $\frac{7}{21}$, or $\frac{1}{7}$ (which is all one:) now this $\frac{7}{21}$ becomes to be $\frac{21}{7}$ of a penny, which

which is equal to 3 *d.* wherefore if you add 3 *d.* to 11 *l.* 19 *s.* 9 *d.* the ſum will then be 12 *l.* or 2880 *d.*

QUEST. 36.

There are 1000 *Loaves of Bread to be divided amongſt three ſorts of perſons; thoſe that were above* 40 *years of age, were to have* 12 *penny Loaves, thoſe above* 20 *years of age, were to have* 6 *penny Loaves, and thoſe above* 10 *years of age were to have* 1 *penny Loaves. How many* 12 *penny Loaves, how many* 6 *penny, and how many penny Loaves muſt there be provided?*

THE Exceſs is { 40, 20, 10 } for the { 1, 2, 3 } ſort of perſons

The ſum —— 70

By the Rule of three ſay,

(1) *If* 70 *require* 1000, *what ſhall* 40.

Multiply 1000 by 40, it produceth 40000; which divide by 70, the Quotient will be $57\frac{2}{7}$, and ſo many 12 penny loaves muſt be provided.

(2) *If* 70 *require* 1000, *what ſhall* 20?

Multiply 1000 by 20, it produceth 20000;

20000; that divided by 70, produceth $285\frac{5}{7}$, ſo many 6 penny loaves.

(3) *If* 70 *require* 1000, *what ſhall* 10?

Multiply 1000 by 10, it produceth 10000; this divided by 70 produceth $142\frac{6}{7}$, and ſo many penny loaves muſt be provided: which added together, (the Fraction-parts excepted) make 1000 loaves.

QUEST. 37.

A Debtor owes his Creditor a certain ſum of Money, of which, becauſe he cannot make one entire payment, he condeſcends to pay it by the weeks in the year, according to this progreſſion, namely, to pay the firſt week 5 s. *the ſecond week* 10 s. *the third week* 15 s, &c. *I would know how much the Creditor received of his Debtor at the years end.*

TO perform this eaſily (for to add 5 *s.* 10 *s.* 15 *s.* 20 *s.* till you come to the end of the 52 weeks, which make a year, would be tedious) do thus;

Firſt, multiply 52 (the number of weeks in the year) by 5 (the increaſe every week) the product will be 260,

which

which is equal to the two and fiftieth number, if you had added the ſums together.

Secondly, to this 260, add 5 (the increaſe for one week) it maketh 265, which multiply by 26 (half the number of weeks in the year) and it produceth 6890 ſhillings, which is 344 *l.* 10 *s.* and ſo much will the Creditor have received of his Debtor at the years end.

QUEST. 38.

A certain perſon by Will, bequeaths his Eſtate to his Executor, enjoyning him every year (ſo long as the Executor lived) to beſtow on certain charitable uſes by him named, a certain ſum of Money encreaſing every year 55 l. *more than the preceding; ſo the firſt year the Executor expended* 55 l. *and the laſt year* 495 l. *How many years lived the Executor after the Donor? and how much to the fore-mentioned Uſes did he expend?*

TO effect this eaſily, Firſt, Subſtract 55 *l.* (the firſt diſburſment) from 495 *l.* (the laſt diſburſment) the remainer

mainer is 440 *l.* which divide by 55 (the Exceſs or increaſe of every years diſburſment) and the Quotient will be 8, to which add 1, and it makes 9; and ſo many years lived the Executor after the Deceaſed.

Secondly, Multiply 55 (the Exceſs) by 9 (the number of years) the Quotient will be 495, which was the laſt diſburſment.

Thirdly, Add 495 and 55 together, they make 550. which multiply by 4½ (which is half the number of years the Executor lived) and the product will be 2475; and ſo much did the Executor expend in all.

QUEST. 34.

A Father gave to his Eldeſt Son 252 l. *and to his Youngeſt he gave but* 28 l. *and to every Son ſucceſſively from the Youngeſt he gave* 28 l. *more than to the other. How many Sons had the Father? and how much Money did all their Legacies amount to?*

FIrſt take 28 (the Youngeſt Son's ſhare) from 252 (the Eldeſt Son's ſhare) the remainer will be 224, which divide

divide also by 28 (because every Son's portion exceeded others by 28 *l.*) and the Quotient will be 8, to which add 1, (for the first son) and it makes 9; so that he had 9 sons.

Now to find what sum of Money all their Legacies amounted unto; add 28 (the Youngest son's share) to 252 (the eldest son's share) and the sum will will be 280; which being divided by $4\frac{1}{2}$ (which is half the number of the sons he had) the product will be 1260 *l.* and so much Money did all their Portions amount unto.

QUEST. 40.

A Bishop dying, left 10000 l. *to be distributed amongst three sorts of men,* viz. *Divines, Lawyers, and Physicians, in such order, that* 40 *Divines were to have* 10 l. *the Lawyers* 5 l. *the Physicians* 1 l. *And* 60 *Physicians were to have their parts out of the Legacy also. I would know what the Divines, Lawyers, and Physicians share will be? And also what will the Portion or share of every Divine, Lawyer, and Physician be?*

First,

First, Multiply 40 (the Divines) by their Exceſs (which is 10 *l.*) and it produceth 400.

Secondly, Multiply the 50 Lawyers by 5 (which is their Exceſs) and it produceth 250.

Thirdly, Add theſe two numbers together, *viz.* 400, and 250, and they make 650, which with the 60 Phyſicians make 710, the total, as here you ſee;

Divines	400
Lawyers	250
Phyſicians	60
In all	

Being thus prepared, ſay by the Rule of Three direct thus:

If 710 perſons have 10000 *l.* amongſt them, how much ſhall 400 perſons have?

Firſt, For the Divines,

Multiply 10000 by 400, it produceth 4000000; which divide by 710, and the Quotient will be 5633 *l.* and $\frac{57}{71}$ of a pound; ſo that the 140 Divines ſhares will come to $5633\frac{57}{71}$ *l.*

Secondly, For the Lawyers,

Multiply 10000 by 250, the product

duct will be 2500000; which divid
by 710, and the Quotient will b
3591 *l.* and $\frac{5}{7}$ of a pound; so t
the 250 Lawyers will have 3591 $\frac{5}{7}$
for their shares.

Thirdly, For the Physicians.

Multiply 10000 by 60, the prod
will be 600000; which divide by 71
and the Quotient will b 845 and $\frac{5}{7}$
a pound. So that the 60 Physicia
will have for their shares $845\frac{5}{7}$ *l.* A
which shares being added together,
make up the just sum 10000 *l.* As he
you see.

400 Divines——	$5633\frac{17}{71}$
250 Lawyers——	$3521\frac{5}{71}$
60 Physicians——	$845\frac{5}{71}$
	10000

Having thus found the gener
shares, it will be now requisite to fi
every particular share: and First, F
every Divines share, say,

If 40 Divines have $5633\frac{17}{71}$ *l.* wh
shall one have?

Divide $5633\frac{17}{71}$ *l.* which is 5633
16 *s.*--0--2 *q.*-$\frac{5}{7}$ *p.* by 40, the Quotie
will be 140 *l.* 16 *s.*-0-3 *q.*$\frac{10}{71}$. for ever
Divines share.

Secondly

Secondly, *For every Lawyers ſhare.* Divide 3521 $\frac{5}{71}$, which is 3521 *l.* -2 *s.* -6 *d.* -1 *q.* $\frac{49}{71}$, by 50, the Quotient will be 70 *l.* 8 *s.* 5 *d.* 1 *q.* $\frac{46}{71}$. for every Lawyers ſhare.

Thirdly, *For every Phyſicians ſhare.* Divide 845 $\frac{5}{71}$, which is 845 *l.* 1 *s.* 4 *d.* -3 *q.* $\frac{49}{71}$, by 60, the quotient will be 14 *l.* -1 *s.* -8 *d.* -1 *q.* $\frac{9}{71}$, for every Phyſitians ſhare.

QUEST. 41.

There are two Cities, which are diſtant 500 Miles and there are two other Cities lying between them: Now from the firſt City to the ſecond the diſtance is not known; but from the ſecond to the third it is 6 times as far as from the firſt to the ſecond, and 15 Miles more. And from the third City to the fourth it is 9 times as far as from the ſecond to the third wanting 16 Miles. How far are theſe 4 Cities one from the other?

LEt the 4 Cities be repreſented by theſe 4 Letters A, B, C, D. and that from A to D it is 500 miles.

Then ſuppoſe, that from A to B it be

be 1 mile, then from B to C it must be 6 miles, and 23 miles more. Then again, from C to D it must be 9 times as much as from B to C, which is 54 miles wanting 16. Set the number as here is done:

from { A to B, is 1 mile.
B to C, is 6 miles, more 23.
C to D, is 54 miles wanting 16.

61 miles, 23 miles want 16 miles.

Add all together as you see here is done, and you shall find the sum to be 61 miles, more 23 miles, less 16 miles, which should be 500 miles.

Now (because there is more 23 miles, and less 16 miles,) substract 16 from 23, and there will remain 7 which 7 substract from 500, and the remainer will be 493; which divide by 61, and the Quotient will be $8\frac{5}{61}$ and that is the distance from the Town A to the Town B.

Then from *miles*
A to B being — $8\frac{5}{61}$, from
B to C must be — $48\frac{40}{61}$ more 23 & from
C to D must be $43\frac{2}{61}$ want 16.

All which sums being added together,

ther, and the Fractions reduced, the ſum of miles will be 500, as by the work underneath doth appear.

From { A to B is $8\frac{5}{61}$. / B to C is $48\frac{3}{1}$, more 23 / C to D is $43\frac{2}{61}$, want 16

Subſtract 16 from 23, reſts —— 7

The ſum of the Denominators of the Fractions is 305, which divided by 61, the Quotient is —— 5

All theſe ſums 8, 48, 432, 7, and 5, added together, make 500, equal to the diſtance between A and D, and proves the work to be true

QUEST. 42.

There is 400 *Crowns to be diſtributed among* 5 *perſons*, A, B, C, D, E, *in this wiſe.* A *muſt have an unknown ſhare*; B *muſt have* 3 *times as many as* A, *and* 6 *more*: C *muſt have* 9 *times as many as* A, *and* 3 *times as many as* B, *wanting* 9. D *muſt have three times as many as* B, 4 *times as many as* C, 2 *times as many as* A, *and* 8 *over*: *And* E *muſt have* 2 *times as many as* C, 3 *times as many as* B, *and* 4 *times as many*

many as A, *wanting* 11. *How many must each person have ?*

SUppose (as in the last Question) A to have 1 Crown, then B must have 3 Crowns and 6 more, and the rest as in this following Collection.

A	1		
B	3	more 6	
C	18	more 18	wanting 9
D	93	more 128	want 36
E	49	more 54	want 29
All	169	more 206	want 74

Substract 74 from 206, and there will remain 132; which 132 substract from 400, there will remain 268; which 268 divide by 169, and the Quotient will be 1 $\frac{99}{169}$. which will be the share, of A, which is 1 Crown, and 586 parts of a Crown divided into 1000 parts; and all the rest of the shares will be (in Decimal Fractions) as followeth,

Crowns

Crowns 1000.

	Parts.
A ——	1. 586
B ——	10. 758
C ——	37. 548
D ——	247. 428
E ——	102. 714
Sum--	400. 034

These are the several shares, and you see the sum of them is just 400, onely there is in the Fraction 34 of a thousand parts too much; which is occasioned because 586 parts is somewhat more than $\frac{2}{16}$.

QUEST. 43.

There is 100 l. *left to be divided among* 3 *persons*, A, B, *and* C, *of which* A *is to have one third*; B *two sevenths*; *and* C *five eights. How much must each person have?*

	l.	s.	d.
$\frac{1}{3}$ of 100 *l.* ——	33	-6-	8
$\frac{2}{7}$ of 100 *l.* ——	28	-11-	5-$\frac{1}{3}$
$\frac{5}{8}$ of 100 *l.* ——	62	--10-	0
The Sum ——	124	-8-	1 $\frac{1}{3}$.

If the Dividend should be thus made, the Executor which pays the Money would lose 24 *l.* 8 *s.* 1 *d.*-$\frac{1}{3}$. for his paying of the Money, and yet every

ſingle perſon would imagine he had but his due. Wherefore to avoid ſuch deceits, work thus in this & the like caſes;

Multiply the Denominators of the Fractions into each other, thus, ſaying, 3 times 7 is 21, and 8 times 21 is 168.

Then divide 168 by each ſeveral Denominator, ſo 168 divided by 3 produceth 56, and divided by 7 it produceth 48, and divided by 8 it produceth 105; the 3 Quotients added together, make 209. See the Work.

	1		56
B	3	of 168 is	48
	2		805
C	7		
	8		
	168		209

Then work by the Golden Rule, ſaying,

As 209 is	56	to	26	— $\frac{168}{209}$
to 100,	48		22	— $\frac{202}{209}$
ſo is	105		50	— $\frac{50}{209}$

The Fractions reduced make compleat pounds } 2.

The ſum —— 100

So that

		l.	s.	d.
A	muſt have	26	12	2
B	muſt have	22	11	4
A	muſt have	50	16	6

In all -- 100·0

And

And in this manner may your eſolve all Queſtions of this kind.

QUEST. 44.

There is a Grand-father which is aged 125 *years: his Son hath a Wife and* 3 *Sons: Now the Father is as old as his Wife and his ſecond Son, and* 4 *years over. The Wife is as old as all her* 3 *Sons, and* 3 *years over. The Eldeſt Son is as old as his two Brothers and* 3 *over. The ſecond Son is* 4 *times the age of the Youngeſt, and* 1 *year over. And all theſe Ages together, are equal to the Age of the Grand-father, namely* 125 *years. Now I would know how old was the Father, Mother and all the* 3 *Sons ſeverally?*

YOu muſt, as in former Examples of this kind, imagine an age for the yonngeſt Son, which we will ſuppoſe to be 1 year; then will the age of the Father, Mother, and the other ſons (according to the Tenor of the Queſtion) be as followeth, *viz.*

Youngeſt ſon — 1 year
Second ſon — 4 years, more 1
Eldeſt ſon — 5 years, more 3
Mother — 10 years, more 3
Father — 14 years, more 4

The ſum — 34 years, more 11

This 34 years more 11, ſhould be equal to 125 the Grand-father's age, but it is not; wherefore from 125 ſubſtract 11, and the remainer will be 114 years; which divide by 34, and the Quotient will be $3\frac{12}{34}$, or (in leſſer terms) $3\frac{6}{17}$ for the age of the Youngeſt ſon, and then the reſt will be,

Youngeſt ſon, years — $3\frac{6}{17}$
Second ſon — $12\frac{24}{17}$ $1\frac{7}{17}$
Eldeſt ſon — $15\frac{30}{17}$ $3\frac{6}{17}$
The Mother — $30\frac{60}{17}$ $3\frac{6}{17}$
The Father — $42\frac{84}{17}$ $4\frac{16}{17}$

The Fractions reduced make — 12

The ſum of all — 125 equal to the age

age of the Grand-father, and the Queſtion truly reſolved.

QUEST. 45.

What whole number is that, which if you divide it by 9, there ſhall remain 8; divide it by 8, there ſhall remain 7; divide it by 7, there ſhall remain 6; and ſo on till you divide it by 2, and then there ſhall remain One.

THe Numbers which have this property are many, and may be found by the continual multiplying of a number through all the 9 Digits, and adding the preceding Digit to the laſt product, as in the following Scheme. Firſt, ſet down all the 9 Digits orderly one under another, and againſt 1 ſet a Cypher; then under one ſet 2, and add 1 and 2 together, they make 3; which ſet under 0, and againſt 2. Then ſay, 3 times 3 is 9, and 2 over 3 is 11; ſet 11 by 3: then ſay, 4 times 11 is 44, & 3 over 4 is is 47; ſet 47 againſt 4: and thus continuing, you ſhall find 725759 to ſtand againſt 9, and that

1	0
2	3
3	11
4	47
5	239
6	1432
7	10079
8	80639
9	725759.

number is capable of all these divisions, and the remainder shall always be one Unite less than the Divisor.

There are infinite other Numbers will be found to have the same property, as namely these following, of which 2519 is the least.

2519
5039
7559
10079
12599
15119
17639
20159
22679
25199

QUEST. 46.

How many Stroaks doth a Clock strike in 12 hours, all the Stroaks being added together?

THis is easie enough to be done: for if you add 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12, all into one sum, you shall find that sum to be 78; and so many Stroaks doth the Clock strike in all. But

But more artificially thus: The hours being 12, take half thereof, which is 6, and that keep; then 12 being the greateſt number, and 1 the leaſt, add them together, they make 13: wherefore multiply 13 by 6, and the product is 78; and that is your number ſought, and ſo many Stroaks doth the Clock ſtrike in 12 hours.

QUEST. 47.

If a man ſhould ſell a Horſe for a penny a Nail for every Nail in his 4 ſhoes, which are 28, according to this rate; for the firſt Nail 2 d. for the ſecond 4 d. for the third 6 d. and ſo on increaſing 2 d. every Nail till the 28 Nails were out: How much money ſhould he receive for his Horſe?

THis Queſtion may be reſolved by the continual addition of 2 *d.* 4 *d.* 6 *d.* *&c.* till you come to the 28*th* Nail, which will be 56 *d.* and then add all the ſums together, which done, they will make 812 *d.* but this way is tedious. Therefore,

More artificially thus: the laſt Nail (or greateſt number) is 56 *d.* and the

firſt Nail (or leaſt number) is 2 *d.* add theſe two numbers together, and they make 58; which multiply by 14, (the half number of the Nails) the product will be 812 *d.* And ſo much Money ſhall he receive for his Horſe, which is 3 *l.*-7 *s.*-8 *d.* And in this manner may you reſolve all Queſtions of this nature.

QUEST. 48.

A Traveller goes a Journey, and goes every day 8 *miles. At the ſame time another Traveller goes the ſame Journey, and goes the firſt day* 1 *mile, the ſecond day* 2 *miles, the third day* 3 *miles,* &c. *I would know in how many days the ſecond Traveller will overtake the firſt, that went* 8 *miles a day?*

EIght, which is the number of Miles that the firſt Traveller goeth in a day, is the middle, or half term, in the Progreſſion: wherefore double 8, and it makes 16; from which take 1, (the number of miles that the ſecond Traveller went his firſt day) and there will remain 15; and in ſo many days will the ſecond Traveller have overtaken

taken the first, they having then travelled 120 Miles.

QUEST. 49.

A Boy getting into a Hen-roost, stole from thence a certain number of Eggs, Another Boy discovering him, he to satisfie him, gave him half his Eggs which he Stole, but he gave him back 12. Then a second Boy accuses him, and he to appease him, gives him half his Eggs remaining, who returns him 7. And meeting with a third accuser, he gives him half his Eggs remaining, who gives him back 4. And when he was clear of all his accusers, he had still 20 Eggs remaining. How many Eggs did the Boy steal at first?

TO resolve this or the like, you must from the 20 which he had left, substract 4 (which his last accuser returns him) and there will remain 16; which double, and there will be 32; from which take 7, there will remain 25; which doubled, makes 50; from which take 12, and the remainer will be 38, of which the double is 76, and that is the number of Eggs which he first stole.

QUEST. 50.

A Young Scholar being come to a Country-Town, where he intended to reside some time, lit into a Gentlemans House where there were in Family the Master, Mistress, and 4 Children, which with himself made 7. At Dinner they discoursed concerning the Scholar's Board there for a year, for which the Gentleman demanded a certain sum; which the Scholar thinking too much, made this overture, that he would give him so much as he did demand of him for a year, provided for that same Money he should have his board so long time as he could daily place those 7 persons at the Table in a several and distinct order, so that they should never all of them sit in the same places as then they did. The Gentleman condescends. The Question is, How many days may the Scholar sojourn with the Gentleman before all these Changes come about?

TO effect this, you must still multiply your preceeding Product by

1) 1
2) 2
3) 6
4) 24
5) 120
6) 720
7) 5040

by the Figure following. Thus, at the firſt day, the perſons ſate at the table as then they did; the ſecond day multiplying 1 by 2, it makes 2, and ſo 2 changes may be made of two perſons, in this manner: 1, 2. 2, 1. Then multiply this Figure by the next day, or 3, and it makes 6; which ſhews that 6 changes may be made of 3 perſons as thus, 1, 2, 3. 1, 3, 2. 2, 1, 3. 2, 3, 1. 3, 1, 2. 3, 2, 1. Then multiply this number 6 by the next Figure 4, it makes 24 changes; this multiplied by 5, makes 120, that multiplied by 6, makes 720; and that 720 multiplied by 7, makes 5040 Changes. So that the Scholar (according to the tenour of this Bargain) might ſojourn there 5040 days; which being divided by 365, the number of days in the year, the the Quotient is 13 years and 295 days which is 14 years wanting only 70 days.

2 3 49 231 2495 5040 (13 3655 36

QUEST.

QUEST. 51.

Three Butchers do buy together a parcel of Sheep, which will coſt them 72 l. Now they do agree together that the ſecond ſhall pay of the Money one third part more than the firſt: And that the third ſhall pay a fourth part more than the ſecond. How much muſt each Butcher pay of that Sum?

IMagine that the firſt Butcher was to pay of the ſum 3 l. then the ſecond muſt pay 4 l. which is one third part more than the firſt. Laſtly, The third Butcher muſt pay 5 l. being one quarter or fourth part more than the ſecond. Theſe three ſums, 3 l. 4 l. and 5 l. make but 12 l. whereas it ſhould be 72 l. Wherefore ſay by the Rule of Three,

If 12 l. come of 3 l. of what 72 l.

Multiply 72 by 3, and the product will be 116; which divide by 12, and the Quotient will be 18: and ſo much of the Money muſt the firſt Butcher pay; then the ſecond muſt pay 24 l. and the third muſt pay 30 l. all which ſums do make 72 l. and the Queſtion is anſwered.

QUEST.

QUEST. 52.

A Man and his Wife did usually drink out a certain Vessel of Beer in 12 *days, and the Husband found by often experience, that in his Wifes absence he cou'd drink it off in* 20 *days. The Question is, In how many days the Wife cou'd drink it off alone?*

FRom 20 (the number of days in which the Husband drank off the Vessel) substract 12, (the number of days in which they both drank it off in) and the remainder will be 8. Then by the Golden Rule say,

As 8 days to 12 days, so 20 days to what?

Multiply 20 by 12, and thereof will come 240, which divided by 8, the Quotient will be 30; and in so many days would the Wife have drank it off alone.

QUEST. 53.

If 3 *pair of Gloves be equal in value to* 2 *pieces of Ribbon;* 3 *pieces of Ribbon to* 7 *dozen of Points;* 6 *dozen of Points to* 2 *Yards of Lace;* 3 *Yards of Lace to* 81 *shillings. How many pair of Gloves may be bought for* 28 *shillings?*

First,

First, Multiply 3 pair of Gloves by 3 pieces of Ribbon, they make 9, which multiply by 6 dozen of Points, it produceth 54, that multiplied by 3 Yards of Lace, produceth 162, and that multiplied by 28 s. produceth 4536 for the Dividend.

Secondly, Multiply 2 pieces of Ribbon by 7 dozen of Points, the product will be 14, which multiplied by 2 yards of Lace, produceth 28: and that multiplied by 81 s. produceth 2268 for a Divisor.

Divide 4536 by 2268, the Quotient will be 2, and so many pair of Gloves will be bought for 28 s.

QUEST. 54.

There is a Gallery to be paved with Stones in the form of a Long Square, each Stone is 28 *Inches long and* 24 *Inches broad, and the Gallery is* 40 *Yards long and* 7 *Yards broad. How many such Stones will pave this Gallery?*

Multiply the length of the Stone by the breadth, that is, 28 by 24, the product is 672 for your Divisor.

Then

Then multiply 40 Yard the length and 7 Yards the breadth, both of them by 36, (the number of Inches in one Yard) and one product will be 1440, and the other 252; which being multiplied together, produce 362880: this number being divided by 672, the former Diviſor, the Quotient will be 540; and ſo many ſuch Stones will pave the ſaid Gallery

QUEST. 55.

A Stationer would lay out 220l. in three ſorts of paper, ſome of 5 s. the Ream, ſome of 6 s. the Ream, and ſome of 11 s. the Ream: of all which ſorts he would have an equal number of Reams. The Queſtion is, How many Reams of each ſort muſt he have?

ADD all the 3 Prizes togther, as 5 s. 6 s. and 11 s. they make 22 s. for your Diviſor; then turn the 200 l. into ſhillings, they make 4400 s. for your Dividend.

Divide 4400 by 22, the Quotient will be 200; and ſo many Reams muſt he have of a ſort. For

200 Reams	at	5 s.	comes to	50
		6 s.		60
		11 s.		110
		22		220

QUEST. 56.

Five Merchants, viz. A, B C, D, E, *have gained* 2025 l. *which is to be divided amongſt them in this ſort: So that the half of* A *his ſhare, ſhall be equal to* $\frac{1}{4}$ *of the ſhare of* B, *to* $\frac{1}{5}$ *of the ſhare of* C, *to* $\frac{1}{6}$ *of the ſhare of* D *and to* $\frac{1}{8}$ *of the ſhare of* E. *I demand each Merchant's ſhare?*

FInd any number that may be divided into ſuch parts as the ſeveral ſhares are to be parts of: Or take the ſeveral Denominators of the Fractions, *viz.* 2, 4, 5, 6 and 8, and add them together, they make 25: Then ſay by the Golden Rule,

If 25 gain 2025 l. what ſhall 2 gain?

Multiply 2025 by 2, the product will be 4050, which divide by 25, the Quotient will be 162 *l.* for the ſhare of A, whereof the half is 81 *l.*

Work

Work ſo with all the reſt of the numbers 4, 5, 6, and 8. and you ſhall find each mans ſhare as is here under expreſſed.

l.					
2(162	for	A	whereof	1	is 81*l.*
4(324		B		$\frac{2}{1}$	
5(405		C		4	
6(496		D		1	
8(648		E		5	
				1	
				6	
				1	
				8	

QUEST. 57.

f a Clock or Dial have 2 Indices or Hands, one whereof goeth about twice in one day, or 24 hours; and the other goes about but once in 30 days or 720 hours. If theſe two Hands be ſet together at the ſame Point, and go both one way, I demand in what time they ſhall again meet together?

TO anſwer this Queſtion, ſay by the Rule of Three,

If 1 day, or 24 hours, require 2 Revolutions, what ſhall 30 days, or 720 hours require?

Mul-

Multiply 30 by 2, and thereof will come 60 Circumferences: from which ſubſtract 1, there remains 59: and from hence it appears, that in 30 days the ſwifter Hand would have gone about 60 times and the ſlower Hand but once: therefore the ſwifter Hand gains of the ſlower Hand 59 Revolutions in 30 days: wherefore, ſay again by the Golden Rule,

If 59 Circumferences require 30 days, or 720 hours, what 1 Circumference?

Multiply 720 by 1, the product will be 720, which divided by 59, the Quotient will be 12 hours $\frac{12}{59}$ of an hour, or 12 hours 12 minutes and 12 ſeconds: and in ſuch time will the 2 Indices, or Hands, meet.

QUEST. 58.

There is an Iſland 36 miles in Compaſs: Now at the ſame time, and from the ſame place two Footmen A, *and* B; *ſet forward to go round the ſame, and they follow one the other in ſuch ſort, that* A *travels every day 9 miles, and* B *7 miles. The Queſtion is, to find in what ſpace of time they would again meet? and alſo how many*

many miles, and how many times about the Iſland each Footman would then have travelled?

TO anſwer this, from 9 miles (the number of miles that A goes in a day) ſubſtract 7 miles, (which B goes in a day) the difference is 2. Then ſay by the Golden Rule.

As 2 miles is to 1 day, ſo is 36 miles to what?

Divide 36 by 2, and the Quotient will be 18; and in ſo many days will they meet.

Again

Multiply 18 by 9, and the product will be 162, and ſo many miles did A travel; which divide by 36 (the compaſs of the Iſland), the Quotient is $4\frac{1}{2}$, ſo that A travelled 4 times and an half about the Iſland. In like manner, multiply 18 by 7, you ſhall find 126, which is 3 times and an half the compaſs of the Iſland; and ſo many times did B travel about the Iſland.

QUEST. 59.

Two Merchants, as A, *and* B, *are in Trade or Company, and the ſum of both*

both their Stocks is 300 l. *The Money of* A *continued in company* 9 *months, and the Money of* B *continued* 11 *months in company; by their two Stocks* 300 l. *is gained; which upon account is equally divided. Now the Question is, to know how much Money each Merchant did put in?*

ADd 11 and 9 (the times that each Merchants money was in ſtock) together, the ſum of them is 20: Then ſay by the Golden Rule, As 20, their ſums of the times, is to 300, the ſum of their Stocks; ſo is 11 months, the time that B his Money was in, to 165 *l.* the Stock that A put in; and ſo is 9 months, the time that A his Money was in, to 135 *l.* the Stock that B put in: ——Now for the proof of this multiply A his ſtock 165, by 9 Months his time, the product will be 1485. — Alſo multiply B his ſtock 135 by 11 months his time, that product will alſo be 1485; which demonſtrates the Work to be true.

QUEST.

QUEST. 60.

Two Merchants A, *and* B, *do Company*; A *put into Stock* 325 l. *more then* B, *and* A *his Stock did continue in Company* 7 *months and an half.* B *put into Stock a certain ſum unknown, and it is continued in Company* 10 *months and* 3 *quarters: After a certain time they divide the gain equally. The Queſtion is, what each Merchant did put in?*

THe difference of their ſtocks was 325 *l.* A continued his ſtock $7\frac{1}{2}$ months; and B his ſtock was in $10\frac{3}{4}$ moneths: ſo that the difference of the time was $3\frac{1}{4}$ months. Wherefore multiply 325, the difference of their ſtocks, by $7\frac{1}{2}$, the time that A his ſtock was in, and the product will be $2437\frac{1}{2}$; which divide by $3\frac{1}{4}$, the difference of time that their ſtocks were in, and the Quotient will be 750 *l.* for the ſtock which B put in; to which add 325 *l.* the ſum which A put in more than B, and the ſum will be 1075 *l.* for the ſtock which A put in.

Arith-

Arithmetical RECREATIONS

Problematically Propounded, and Answered.

TO the foregoing *Questions*, I will here add certain *Problems*, and give the *Answers* of them in general terms, leaving the Arithmetical Working of them to the Ingenious Practitioner, thereby the better to confirm him in his undertakings, to resolve other *Questions* that may be proposed to him.

PROBL.

PROBLEM I.

There were 6 Cups of Gold which weighed together 600 Ounces, but each Cup was heavier than the other by one ounce; now how much did each Cup weigh severally?

Answer. ONe (and the least of the Cups) weighed 97 ounces and a half; the next 98 and a half; the third 99 and a half; the fourth 100 and a half; the fifth, 101 and a half, and the sixth and biggest weighed 102 ounces and a half: all which numbers being put together, make 600 ounces, equal to the whole weight.

PROBL. II.

There are four several Measures, as A, B, C, D, *of which* D, *holds* 24 *pints, and* C *holds as much again as* B, *and* 3 *times as much as* A, *and* D *with twice* A, *will hold double as much as* C, *and four times as much as* B. *How much did every one of these Measures hold severally?*

Answer,

Answer.

A	holds	6	Pints.
D		24	
C		18	
B		9	

So that C holds as much again as B, and three times as much as A, and D, with twice A, holds as much as C, and four times as much as B.

PROBL. III.

A Father leaves 1000*l. to be disposed of to his Son and Daughter, conditionally thus; That the fifth part of that which his Son should have, should exceed the fourth part of that which the Daughter should have, by* 10 *l. What must each have?*

Answer. THe Son had 577 *l.* and $\frac{2}{3}$ of a pound; and the Daughter 422 *l.* and $\frac{1}{3}$ of a pound. Now the fifth part of $577\frac{2}{3}$ is $115\frac{8}{15}$; --And the fourth part of $422\frac{1}{3}$ is $105\frac{5}{12}$; which is less than $115\frac{8}{15}$ by 10: — And $577\frac{2}{3}$, and $422\frac{1}{3}$ being added together, do make 1000 *l.* equal to the whole Legacy.

PROBL.

PROBL. IV.

One coming into an Orchard, asked the Gardener how many Trees there were in that Orchard? the Gardener answered, That the one half of the Trees were Apple-trees, the Quarter-part Pear-trees, the seventh part were Plumb-trees, and that there were 12 Cherry-trees besides. How many Trees were there in this Orchard?

Answ. THere were 112, the half whereof is 56, the quarter thereof is 28, and the seventh part is 16; these three Numbers added together, make 100; which with the 12 Cherry-trees make in all 112 Trees in the Orchard.

PROBL. V.

Two Persons, as James *and* Paul, *had between them a certain number of Sheep in two Droves*; James *said to* Paul, *If you put 70 of your Sheep into my drove, I shall have 3 times as many Sheep as you have. But* Paul *said to* James, *If you put 70 of yours into my drove, I shall have five times as many as you. How many Sheep had each of them?*

Anſw. JAmes had 110, and *Paul* had 130, —— For if you take 70 from *Paul* and add them to *James*, then *James* will have 180, and *Paul* but 60, which is but one third part of what *James* hath: —— But if you take 70 from *James*, and give them to *Paul*, then *Paul* will have 200, and *James* but 40; which is but one fifth part of what *Paul* hath.

PROBL. VI.

The Father and Son travelling together, each of them carrying a certain number of Bottles of Wine; the Son complains to the Father, that he was overladen: the Father replied, If I ſhould take one of your bottles, then I ſhould have as many more bottles as you have; and if I ſhould give you one of mine, yet I ſhould have as many as you have in all ſtill. How many bottles had each of them?

Anſw. THe Father had 7, and the Son had 5. —— So if the Father had taken one of the Son's Bottles from him, the Son would have had but 4, and the Father 8, which is double

ble the Son's number: and if the ſon had taken one from the Father, then they would have been both equal, for either of them would have had 6 Bottles.—Many other Nnmbers may be found to do the like, which I leave for you to diſcover.

PROBL. VII.

One having in the Market a basket of Apples, another comes and asks him how many there is of them? the owner replies, he cannot tell; but he remembers that when he told them into his basket by two and two, there was one odd one at laſt: Alſo when he told them in by three and three, there was ſtill one odd one; and alſo by four and four, there was ſtill an odd one remaining; the like when he told them in by five and five, and by ſix and ſix, ſtill one odd one remained: but when he told them in by ſeven and ſeven, then they fell even. How many Apples were there in his basket?

Anſw. HE had 721, which number being divided by 2, or 3, or 4, or 5, or 6, there will ſtill remain

main 1; but being divided by 7, there will remain nothing.

For 2, 3, 4, 5, 6, being multiplied continually into themselves, will at length produce the number 720, to which add a Unite, and it is 721, the number sought. — There are many other numbers which will afford the like, which I leave to your practice to find of your self.

PROBL. VIII.

If one should buy 12 *Loaves of bread for* 12 *pence, so that some of them may be two-penny Loaves, some penny Loaves, some half-penny Loaves: and some farthing Loaves. How many of a sort must he buy?*

Answ. HE must buy 3 two-penny loaves, 4 penny loaves, 3 half-penny loaves, and 2 farthing loaves.

For

For,	*d.*
3 two-penny loaves are	6
4 penny loaves are	4
3 half-penny loaves are	1½
2 farthing loaves are	0½
12 Loaves — Pence	12

There are other Numbers will do the ſame; which I leave to your finding out.

PROBL. IX.

There is 1000 l. *to be diſtributed amongſt* 10 *perſons, namely, ſome Men, ſome Women, ſome Male-children, and ſome Female children; with this condition, That every Man muſt have* 50 l. *every Women* 70 l. *every Male-child* 130 l. *and every Female-child* 150 l. *How many muſt there be of each ſort?*

Anſw. THere may be 2 Men, 3 Women, 3 Male-Children, and 2 Female-Children.

For,	*l.*
2 Men, at 50 *l.* a peice, muſt have	100
3 Women at 70 *l.* muſt have	210
3 Male childr. at 130 *l.* muſt have	390
2 Fem. childr. at 150 *l.* muſt have	300
10 Perſons.	Pounds 1000

There are other Numbers will do the like, which I leave for your practice to find out.

PROBL. X.

A man dying, and leaving ſeven Sons, bequeaths his Eſtate in money to be thus divided; One half to his Eldeſt Son, the half of the remainer to his ſecond Son, the half of the remainder to his third Son; and ſo to all the ſeven; and the remaining half to an Executor, to ſee his Will performed; which remaining half was 341. *What was his whole Eſtate? and what every Childs part?*

Anſw. HIs whole Eſtate was 8670 *l.* And of this, the Executor

	l.
tor had	34
The ſeventh ſon had	68
The ſixth ſon	136
The fifth	272
The fourth	544
The third	1088
The ſecond	2176
The firſt	4352
In all	8670

PROBL. XI.

A man dying, gave to his Eldeſt Son $\frac{2}{3}$ *of* $\frac{1}{4}$ *of his Eſtate; to his ſecond Son* $\frac{1}{7}$ *of* $\frac{1}{2}$ *of his Eſtate; and when they had counted their Portions, the one had* 40 *l. more than the other: the remainder of the Eſtate was given to the Wife and younger Children. The Queſtion is, How much was the firſt and ſecond Sons Portions? and how much was left to the Wife and younger Children?*

Anſw. THe Eldeſt ſon's Portion was 100 *l.* The ſecond ſon's 60 *l.* And for the Wife and younger Chil-

PROBL. XII.

One delivered to a Banker a certain ſum of money, to have of him by the year only ſimple Intereſt, at the rate of 6 per Cent. *and at the end of* 10 *years he received of the Banker* 500 l. *in full for Principal and Intereſt. What was the ſum at firſt delivered?*

Anſwer, 312 *l.*-10 *s.*

PROBL. XIII.

One man in a Morning demanded of another what it was a clock? The other anſwered, If you add the $\frac{1}{4}$ *of the hours which be paſt ſince Midnight, to the* $\frac{2}{3}$ *of the hours which are till Noon, you ſhall know the true hour that now it is: What was it then a Clock?*

Anſw. Five hours and 41 Minutes, and ſomewhat better.

PROBL. XIV.

A Dog, a Wolf, and a Lyon, are to devour a Sheep; and ſuppoſing that the Dog could eat up the Sheep in one hour, the Wolf in 3 *quarters of an hour, and the*

the Lion in half an hour: Now if the Lion begin to eat 7 Minutes and an half before the Dog and Wolf, and afterwards all three eat together; In what time will the Sheep be devoured?

Anſw. THE Sheep would be devoured in 17 Minutes and 35 ſeconds of time.

PROBL. XV.

If a Houſe be to be built by 3 Bricklayers A, B, *and* C, *they working in ſuch ſort, that* A *alone will finiſh it in* 30 *days,* B *alone in* 40 *days, and* A B *and* C *together in* 15 *days; In what time could* C *alone build that houſe?*

Anſwer. In 120 days.

Concerning two Neighbours Changing of their Land.

Two Neighbours had either of them a peice of Land, the one Field was four-ſquare, every ſide containing 120 *Perches, ſo that it was round about* 480

Perches. The other was ſquare alſo, but the ſides longer than the others Field, and the ends ſhorter: for the ſides of this field were 140 Perches long apeice, and the ends thereof were 100 Perches apeice; ſo that this Field was 480 Perches about as well as the other. Now, which of theſe two had the beſt Bargain?

IT is wonderful to ſee how Numbers will diſcover that to be erronious and abſurd, which to common ſenſe & mans apprehenſion appears reaſonable; as in this Bargain.—Firſt, For the field, which is 120 Perches on either ſide. —Multiply 120 by 120, and the product is 14400: and ſo many ſquare Perches doth that piece of Land contain, that is 80 Acres. —Then for the other field,—Multiply 140 (the length of one of the longer ſides of the field) by 100 perches, (one of the ſhorter ſides) and the product will be 14000 perches, the content of the other field; which is leſs then the former by 400 perches, that is two Acres and an half. And ſo much would he have loſt that had

had the field of 120 perches on every ſide, though the other field were as much about.

And this error would ſtill grow greater, the narrower the ſecond field had been: As ſuppoſe the ends or ſhorter ſides thereof had been but 40 Perches apiece, and the longer ſides 200 apiece, this field would ſtill have been 480 perches about: But let us ſee how much it contains. — Multiply 200 the longer ſide, by 40 the ſhorter ſide, and it will produce 8000: and ſo many ſquare Perches will it contain, which is but 50 Acres: So that if he had chang'd for this field, which is as much about as his, he would have then loſt 30 Acres by the bargain.

About the borrowing of Corn.

A Country-Farmer had in his Houſe a Veſſel of wood full of wheat, which was 4 foot high, 4 foot broad both at top and bottom; and in all parts 4 foot, as the ſides of a Die. — One of his Neighbours deſires him to lend him half his wheat till Harveſt; which he doth: Harveſt coming, and his Neighbour is

to

to repay; he makes a Veſſel 2 foot every way, as his Neighbours was 4 foot every way, and fills him that twice, in lieu of what he borrowed. Was there gain or loſs in this particular?

EXamine firſt what either of theſe Veſſels will hold, and by that you will diſcover the falſacy. — *Firſt*, The Veſſel 4 foot high contains 48 Inches of a ſide: wherefore multiply 48 by 48 and the product will be 2304; which multiply again by 48, and the product will be 110592: and ſo many Cubical, or ſpuare Inches of Corn did his Veſſel hold; the half whereof, which is 55296, he lent his Neighbour. Now *Secondly*, Let us examine how much the ſecond Veſſel will hold, it being 2 foot on every ſide, that is 24 Inches.——Multiply 24 by 24, and the product is 576; which divide again by 24, and the product will be 13824; and ſo many Cubical or ſquare Inches did the leſſer Veſſel contain; which being filled twice, it made 27648 Cubical Inches of Corn or Wheat; which was all he paid his Neighbour in lieu of the 55296 Inches

which

which he borrowed; which is but the juſt half: and ſo allowing 2256 Cubical Inches of wheat to make a Buſhel, (for ſo many there is in a Buſhel) he paid his Neighbour leſs by 12 Buſhels, and about a Peck, than he borrowed of him. And this, and the reaſon of it, is evident, as I will demonſtrate to you by a familiar preſident. —— If you cauſe a Die to be made of one Inch every ſide, and 8 other Dies to be made of half an Inch every ſide; theſe 8 being laid cloſe one to another in a ſquare form, theſe 8 will be but of the ſame bigneſs with the other one Die, whoſe ſide is but an Inch.

A bargain between a Farmer and a Goldſmith.

A rich Farmer being in a Fair, eſpies at a Goldſmith's Shop a Neck-lace of Pearl, upon which were 72 Pearls: The Farmer cheapning of it, the Goldſmith asked 30s. a Pearl: at which rate the Neck lace would come to 103 l. The Farmer looking upon it as dear, goes his way, offering nothing: Whereupon the Goldſmith calls him, and tells him

if he thought much to part with Money, he would deal with him for Corn: —— *To which the Farmer hearkens, asks him how much Corn he would have for it at two ſhillings the Baſhel: The Goldſmith told him, he would be very reaſonable, and would take for the firſt Pearl one Barly-Corn only, for the ſecond two Corns, for the third four Corns, and ſo doubling the Corns till 72 Pearls were out. To this the Farmer agrees, and immediately ſtrikes the Bargain: But ſee the event.*

HE that hath any skill in Numbers, will eaſily diſcern the vanity that there is in this kind of bargaining; ſo that no man can be bound to them: For Numbers increaſing in a Geometrical Progreſſion, do ſo prodigiouſly increaſe, that (to thoſe that are ignorant of the reaſon) it will ſeem impoſſible they ſhould do ſo; but that it is ſo, will appear evident by this bargain, if you enquire, *Firſt*, The quantity: *Secondly*, The worth of ſo much Barly in Money: and, *Tirdly*, the weight of it, and how it ſhould be removed, or where ſtowed. Wherefore,

1. If

1. If we allow 10000 *ten thouſand* Corns to a Pint, which is more than enough) then 5120000 Corns will make a Quarter: but yet (for the eaſe of them that will make trial) we will allow 10000000 Corns to make a Quarter; by which number if you divide the whole number of Corns that the 72 Pearls would have amounted unto, being doubled, (which by cutting off the 7 laſt figures towards the right hand) the Quotient of that Diviſion would be

472236648286964:

and ſo many whole Quarters of Barley would the Neck-lace have amounted unto, and ſome odd Buſhels, which we here omit as ſuperfluous.

2. Now for the worth of this Barley, ſuppoſe it were ſold at 15*d.* the Buſhel, (which is a reaſonable rate) that is 10*s.* the Quarter: wherefore divide the foregoing number of Quarters by 2; that is, take half of it, and it will be 236118324143482 pounds Sterling; which ſum rendred in words, is, *Two hundred thirty ſix millions of millions, one hundred and eighteen thouſand, three hundred twenty four millions, one hundred*

hundred forty three thouſand, four hundred eighty two pounds. A vaſt ſum of Money for a Farmer. And thus, if you reckon Land for ever worth 20 years purchaſe, if you divide this ſum of pounds by 20, the Quotient being 1180591620217 4, is the yearly Rent thereof: which is, *Eleven millions of millions, eight hundred and five thouſand nine hundred and ſixteen millions, two hundred and two thouſand, one hundred and ſeventy four* pounds a year. And again, if you divide this number of pounds by 365 (the number of days in a year) the Quotient will be 3234975918; that is, *Thirty two thouſand, three hundred forty four millions, nine hundred ſeventy five thouſand, nine hundred and eighteen* pounds a day for ever. So great vanity may be agreed and concluded upon by people ignorant of this Science, and for want of ſerious premeditation. But,

3. Let us conſider the weight of ſo much Barley. If we allow 8 Buſhels (or one Quarter) to weigh two hundred weight; (but doubtleſs it weighs more) then the whole number of Quarters Multiplied by 2, gives the weight

weight of all the Barley to be 944473296573928 hundred weight. And if you divide this number by 20, the quotient will be 47223664828696 Tuns; that is, *Forty ſeven millions of millions, two hundred twenty three thouſand, ſix hundred ſixty four millions, eight hundred twenty eight thouſand, ſix hundred ninety ſix* Tuns; which will require 47223664828; that is, *Forty ſeven thouſand two hundred twenty three millions, ſix hundred ſixty four thouſand, eight hundred twenty eight* ſhips of a thouſand Tun a peice to carry it. And to conclude, If there were *Four millions* of Nations in the World, and every one of thoſe Nations had *Ten thouſand* ſail of ſuch ſhips of a *Thouſand* Tun apeice; yet all thoſe ſhips would not contain it. Thus by this you may ſee, how prodigiouſly Numbers do increaſe, being multiplied according to Geometrical Progreſſion.

Concern-

Concerning an Agreement that a Country-Fellow made with a Farmer.

A Country Fellow comes to a Farmer, and offers to ſerve him for 8 *years; all which time he would require no other Wages than one grain of Corn, and one quarter of an Inch of Land to ſow it in the firſt year; and Land enough to ſow that one Corn, and the encreaſe of it, for his whole* 8 *years: to which the Farmer aſſents.*

THeir Bargain being thus made, let us conſider what his eight years ſervice will be worth. For the firſt year he hath only one quarter of an Inch of Ground, and one Corn; which Corn we will ſuppoſe had in the Ear at the years end 40 Corns, (for that is few enough:) then the ſecond year he muſt have 40 ſquare quarters of Inches of ground to ſow thoſe 40 Corns in, that is, 10 ſquare Inches of ground. And the third year, ſuppoſing thoſe 40 Corns to produce

40

40 Ears, and in each Ear 40 Corns, as before, they will be in the third year increaſed to 1600 Corns; ſo that he muſt have 1600 ſquare quarters of Inches to ſow that increaſe in, which is 40 ſquare Inches: and thus continuing till the 8 years be expired, the increaſe would be 655360000000 Corns; that is, *Six millions of millions, five hundred fifty three thouſand and ſix hundred millions* of Corns; and ſo many ſquare quarters of Inches of Land muſt he have to ſow this increaſe in. Now know, that 36000000000 Corns, that is, *Three thouſand and ſix hundred millions of ſquare Inches*, do make a mile, upon the ſuperficies or plain; and that ſuperficies of a Mile will be capable to receive 14400000000; that is, *Fourteen thouſand and four hundred millions of Corns*: wherefore divide 655360000000 (the whole number of the corns increaſe) by 14400000000, (the number of Corns that one Mile ſquare of Land is capable to receive) and in the Quotient you ſhall have 455; and ſo many Miles ſquare of Land muſt there be, to contain the ſowing of the increaſe of one Corn in

in 8 years, which will be about 420000; that is, *Four hundred and twenty thouſand* Acres of Land; which being rated at half a Crown an Acre by the year, it will amount unto 50000, that is *Fifty thouſand* pound: which is 6250, that is, *Six thouſand two hundred and fifty pound a year*: A very conſideradle Salary for eight years ſervice,

By theſe and the like Contracts, we may ſee what abſurdities are and may eaſily be committed, which you ſee the ſubtilty of Numbers eaſily diſcovers. I will give you by way of Diſcourſe, ſome preſidents concerning the increaſe of Creatures of ſeveral kindes, which you may make trial of for your Recreation: As,

I.

WHat think you, if one ſhould tell the Great *Turk* (or any other Potentate in the world, who hath a great Army in the field in continual pay) that all the Revenue appertaining to his Crown, will not for one years time maintain all the Pigs that one Sow, with

with all the Pigs of her race, and the increaſe iſſuing of them, ſhall produce in 12 years; notwithſtanding he can maintain ſo great an Army in the field. Doubtleſs, he would take it unkindly: But conſider; Imagin the Sow brings forth but 6 Pigs at a Litter; of which we will allow two to be Barrow, (and this ſuppoſition is as little as may be) and then imagine that every of thoſe 4 bring as many every year, and the increaſe of them the like, during the term of 12 years; they and their race at the end of the time will be encreaſed to *Three and thirty millions of* Pigs: Now if we allow 5 ſhillings for to maintain one of theſe Pigs for a year, which is not full half a farthing a day: yet there muſt be *Three and thirty millions of Crowns* to maintain them one year: which will make a great hole in a large Revenue.

II.

Would any man (that hath not ſkill in Numbers) imagin that 100 Sheep, and the increaſe thereof, being preſerved for the ſpace of 16 years, ſhould be

be worth above *One Million ſix hundred and twenty thouſand pound* Sterling? Yet if every ſheep do produce but one every year, at the expiration of 16 years, 100 ſheep will increaſe unto 6553600, which is, *ſix Millions, five hundred fifty three thouſand, ſix hundred ſheep.* Now ſuppoſing theſe to be worth but five ſhillings a peice, they would, at that rate, amount unto 1638400: that is, *One Million ſix hundred thirty eight thouſand, four hundred pounds* Sterling.

III.

IN Numbers there is a ſubtile Property, which ſome have above others; of which I will give you a few: As,

1. Is it not ſtrange that there is but one whole Number to be found, which being doubled, ſhall produce the ſame ſumm as it would if it were multiplied in it ſelf ſquarewiſe? and that is the number 2: For 2 and 2 added together, make 4; and ſo if you multiply 2 by 2, it ſhall produce 4 alſo; and you can find no other whole

whole number which hath the like property.

2. There is a ſecret property in the Numbers 5 and 6; for if you multiply either of theſe numbers in themſelves, the numbers produced by thoſe Multiplications, ſhall terminate or end in themſelves; as 5 multiplied by 5, produceth 25, which alſo ends in 5. Likewiſe 6 multiplied by 6, produceth 36, which terminates in 6 alſo. Alſo if any greater numbers ending in 5 or 6, be yet farther multiplied by 5 or 6, they will continually terminate or end in 5 and 6. So 325 multiplied by 5, produceth 1625; and 746 multiplied by 6, produceth 4476; the one ending in 5, the other in 6.

3. The number 9 hath a priviledge above all other numbers; for if you take any number, the nines taken in the groſs ſumm altogether, or in the parts ſeverally, will be ſtill the ſame; as in the number 36, it makes 4 times 9; ſo that if you take the nines out of 36, they are in number 4; and if you multiply 9 by 4, it will alſo produce 36; alſo if you take the nines

out

out of 240, it is all one as if you ſhould take the ſumm of the ſimple figures 2, 4, and 0; for 2 and 4 is 6; ſo if you divide 240 by 9, you ſhall find 6 remaining, which is equal to 4 and 2.

4. There is a fine harmony between theſe two numbers, 220, and 284 that the aliquot-part of the one, do make up the ſumm of the other; as thus, the parts of 220 are 110, 55, 44, 22, 20, 11, 10, 5, 4, 2, 1, the ſumm of which aliquot-parts do make 284; and the aliquot-parts of 284, are 142, 71, 4, 2, 1; which added together, make 220: and this harmony is not to be found in many other numbers.

5. But the number 6 hath an eminent Propriety, for his parts are equal to himſelf; thus his half, which is 3, his third, which is 2, and his ſixth part, which is one, being added together, do make 6; and how rare ſuch numbers are to be found, do you judge; for between One, and —— 1000000000000, that is, *One million of millions*, there are but Ten of ſuch numbers

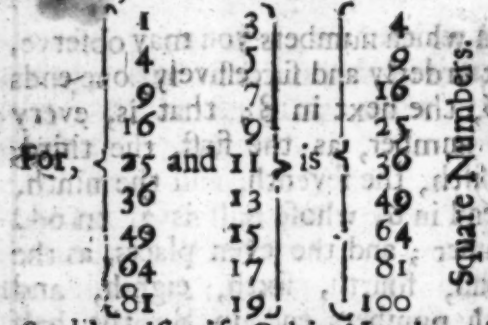
numbers to be found, and those are these that follow:

1	6
2	28
3	486
4	8128
5	120816
6	2096128
7	33550336
8	536854528
9	8589869056
10	137438691328

In which numbers you may observe, that orderly and successively, one ends in 6, the next in 8; that is, every odd number, as the first, the third, the fifth, the seventh, and the ninth, do end in 6, whose half is 3, an odd number; and the even places, as the second, fourth, sixth, eighth, and tenth numbers end in 8, the half thereof being 4, an even number. And if you proceed to find more of these numbers, you may find the twentieth number, that hath this quality, to be ——

= 1511157274515537689313 28.

6. In Square and Cube Numbers, there are ſubtile Properties; as, if from an Unite you do ſucceſſively add the odd numbers, all thoſe numbers ſhall be ſquare numbers; as if to 1, or Unity, you add the next odd number, which is 3, the ſumm is 4, a ſquare number; to which add 5, the next odd number, and the ſumm is 9, a ſquare number alſo; to which add 7, the next odd number, and the ſumm is 16, a ſquare number alſo; and ſo on, as in this little Table.



So likewiſe, if Cubic Numbers be ſucceſſively added from Unity, theſe Numbers ſhall alſo be ſquare Numbers.

7. It is worth the obſerving, that no exact ſquare number can end with any of theſe figures; as 2, 3, 7, or 8.

Compen-

Compendious

RULES

IN

Arithmetic,

By which

Some ſeeming Difficulties, and common Obſtacles are removed, and the Performance of them rendered familiar and eaſie.

Compendium 1.

In the dividing of any great ſumm, how you ſhall certainly know what Figure to put in your Quotient; ſo that you ſhall never take too much, nor too little, but always the right; and divide your ſumm by Subſtraction only, without Multiplication.

FIrſt, write down all the nine Digits orderly one under another, and then by the ſide of them draw a right line, and againſt the figure 1, towards your right hand, ſet down your Diviſor; and multiply it by all the 9 Digits, ſo ſhall you ſee againſt every figure how much the Multiplication of your Diviſor by any Digit will amount unto: So that when you ſee your Remainer in your Diviſion, look in this little Table for the neareſt number leſs than your Remainer; and that figure which ſtandeth againſt that Number, you muſt always put in your Quotient.

Exam-

Example.

Suppoſe you were to divide any great ſumm (as 98204602) by 3989, your firſt work is to ask, How many times 3989 (your diviſor) can you have in 9820, the four firſt figures of your dividend.—Look in this little Table for the neareſt number you can to 9820, which is leſs, and you ſhall find the neareſt number leſs to be 7978, which number ſtandeth againſt the figure 2; wherefore ſet 2 in your Quotient, and ſubſtract 7978 out of 9820, and there will remain 1842; to which the next figure of your dividend being added, makes it 18424. Then you are to ask, how many times 3989 you can have in 18424. Look in your Table for the neareſt number to 18424, and you ſhall find the neareſt leſs to be 15956, againſt which ſtands the figure 4;

	Diviſor.
1	3989
2	7978
3	11967
4	15956
5	19945
6	23934
7	27923
8	31912
9	35901

therefore place 4 in the Quotient, and ſubſtract 15956 out of 18424, and there will remain 2468; which with the next figure of your Dividend 6, maketh 24686. Then ask how often you can have 3989 in 24686; the neareſt number in the Table leſs than this, is 23934, againſt which ſtands 6; place 6 in your Quotient, and ſubſtract 23934 from 24686, and there remains 752; which with the next figure of your Dividend 0, makes 7520. Then ask how often you can have 3989 in 7520; look for the neareſt number to 7520, and you ſhall find the neareſt number leſs to be your Diviſor, 3989, ſtanding againſt the figure 1; wherefore place 1 in the Quotient, and ſubſtract 3989 out of 7520, and there will remain 3531, which with the next figure of your Dividend 2, maketh 35312. Then ask how many times 3989 can you have in 35312; the neareſt number in the Table leſs, is 31912, againſt which ſtands the figure 8; ſet 8 in your Quotient, and ſubſtract 31912 from 35312, and there will remain 3400. And ſo is your Diviſion ended.

ed, the Quotient being 24618, and $\frac{3400}{3989}$ remaining.

I have here inserted this Example, though not after the usual way of Division; but it may be used to any kind, as well as this.

(3400 *Remai.*
3531
752
2468
1842
Divis. 3989) 98204602 (24618
..... *Quot.*

7978
15956
23934
3989
31912

98204602 *Proof.*

The making of the little Table is easie, it being made by *Addition* only, thus: Having set down your *Divisor*, 3989, double it, and it is 7978;

which ſet againſt the figure 2; then add them two numbers together, and they make 11967, which ſet againſt the figure 3; then to that number add 3989, and it makes 15956, which ſet againſt the figure 4; to this add ſtill the firſt number (your Diviſor) 3989, and it will produce the Numbers as in the Table; and ſo muſt you do with any other Diviſor.

And by this means *Multiplication* and *Diviſion*, which are the two difficulteſt parts of Arithmetic, are eaſily and exactly performed by *Addition* and *Subſtraction*, without any charge to the Memory.

Compendium 2.

In caſe a falſe Figure be placed in the Quotient of any Diviſion, how to rectify that Quotient without beginning the Work anew.

WHen you have divided any Summ, if the Remainer at laſt be either greater or equal to the Diviſor, the Quotient is falſe; which may be rectifyed without beginning the Work again,

again, by dividing the Remainer only by the ſame Diviſor; for thereof will ariſe a new Quotient, which added to the former Quotient, the ſumm of them will be the true Quotient.

So if 7290 be divided by 27, the numbers being placed according to the uſual way of Diviſion.

Becauſe 27 can be had in 72 but twice, ſet 2 in the Quotient, ſaying, two times 27 is 54, from 72, and there remains 18, which write over 72, cancelling your other figures: Then ſay, How many times 27 in 189? ſay 7; but if you ſhould miſtake, and write 5 in the Quotient, and ſay, 5 times 27 is 135, out of 189, there remains 54, which write down as before, and remove the Diviſor, and ſay, How many times 27 in 540? the anſwer is 20, but muſt never be above 9: Say therefore, 9 times 27 is 243, out of 540, and the remainer is 297, which being the laſt remain (and greater than the Diviſor) ſhews the Work

2
59
1847
7290(259
2777
22

to be false, and the Quotient 359 to be too little.

Wherefore, divide the last remainer 297 by 27, and the Quotient will be 11, and nothing remaining; wherefore, if you add this Quotient 11, to the other Quotient 259, the sumn of them 270, will be the true Quotient of 7290, divided by 27.

Compendium 3.

How to abbreviate your Work in Multiplication and Division, when your Multiplier or Divisor consists of an Unite, with 1, 2, 3, or more Cyphers.

1. THus, if 365 were to be multiplied by 10, add one Cypher thereunto, making it 3650, and it is done: if it were to be multiplied by 100, add 2 Cyphers to it; if by 1000, add 3 Cyphers to it, and your Work is ended.

In Division likewise, if 763258 were to be divided by 10, cut off the last figure towards the right hand, and the rest of the figures is the Quotient; so the Quotient of 763258 di-

divided by 10, is (76325 $\frac{8}{10}$: if by 100, it is (7632 $\frac{58}{100}$: if by 1000, it is (763 $\frac{258}{1000}$, &c.

3. Alſo if the Multiplier conſiſt of one or more Cyphers in the laſt place, you may omit the multiplying of them, and ſet them down at laſt; as if it were required to multiply 3257 by 2600;

Place the Numbers as you ſee here done; then multiply 3257 by 26, the product will be 84682; to which if you add two Cyphers for the two Cyphers in the Multiplier, then it will be 8468200, which is the true Product.

3257	
2600	
19542	
6514	
8468200	

4. Alſo if Cyphers be in the middle of the Multiplier among other figures, you may abbreviate your Work by removing your next figure a place farther where any Cypher comes.

As if 682357 were to be multiplied by 30204: Place the figures as is here done;

682357

682357
30204

2729428
1364714
2047071

20609910828

Then Multiply 682357 by 4, it produceth 2729428; then (becauſe a Cypher is next) skip one place, and multiply it by 2, it produceth 1364714. ſetting your 4 two places from your right hand towards the left: then for the next place, being a Cypher, do the like, ſetting your Multiplication by 3, namely 2047071, two places yet forwarder towards the left hand; then add theſe three lines together, in the ſame order they now ſtand, and they make 20609910828, which is the true Product of that Multiplication.

Compendium 4.

How you may moſt compendiouſly and ſpeedily multiply by any of the nine Digits, without charging of the Memory.

I. *To Multiply any Number by 2.*

EIther double it, or ſet it down twice, and add the two ſumms together; but it is beſt done by doubling it in your mind.

So if you were to multiply 73684 by 2, it being ſet down once, begin at the right hand, and ſay, 4 and 4 is 8; ſet down 8, then 8 and 8 is 16, ſet down 6 and carry 1; then ſay 6 and 6 is 12, and 1 carried is 13, ſet down 3 and carry 1; then ſay 3 and 3 is 6, and 1 is 7, ſet down 7. Laſtly, 7 and 7 is 14, which being the laſt figure, ſet 14 down, and your Multiplication is ended, and will ſtand thus:

147368.

II. *To*

II. *To Multiply any Number by* 3.

To the Number given, add the double thereof, the ſumm of them ſhall be the product.

So if you were to multiply 73684 by 3, firſt double it, or multiply it by 2, as before, and it maketh 147368, to which if you add the given number 73684, the ſumm of them will be 221052, which is equal to the product as by the Work appears.

73684 Number given.
147368 its double.

221052 Multiplied by 3.

III. *To Multiply any Number by* 4.

Double the Duplication thereof, and your work is ended.

So if you were to multiply 73684 by 4, the Duplication thereof was 147368, which being doubled in your mind, or otherwiſe ſet down, giveth 294736, which is the product of 73684 mul-

multiplied by 4, as here appeareth:

73684 Number given.
147368 its Duplication.

294736 Multiplied by 4.

IV. *To Multiply any Number by* 5.

To the Number given add a Cypher, or in your mind conceive one to be added: the half of that number is the product thereof multiplied by 5.

So if you were to multiply 73684 by 5, ſet, or conceive a Cypher after the 4, then it is 736840: then beginning at the left hand, ſay, The half of 7 is 3, and 1 remaining: ſet down 3, and in your mind carry 1 to 3, making it 13: Then ſay, The half of 13 is 6, and 1 remaining: ſet down 6 and carry 1: then the half of 16 is 8, ſet down 8: then the half of 4 is 2, ſet down 2: Laſtly, the half of 0 is 0, ſet down 0, and your work is ended: the product 4 being 368420, as by the Work appears.

(Cypher added.
736840 the number given, with a
368420 its multipication by 5.

V. To

V. *To Multiply any Number by 6.*

To the Number given add a Cypher; then take the half of that number, and to it add the number given, the ſumm of them ſhall be the product of the given number multiplied by 6.

So if you were to multiply 73684 by 6, add a Cypher thereto, and it is 736840, the half whereof is 368420, to which if you add 73684 (the number given) the ſumm of them will be 442104, which is the product of 73684, being multiplied by 6. As here appeareth.

(Cypher added 736840 the number given, with a 368420 the half thereof.
73684

442104 the product multiplied by 6.

VI. *To Multiply any Number by 7.*

To the Number given add a Cypher, and take the half thereof; add this half to the double of the number given, the ſumm thereof ſhall be the pro-

product of the given number multiplied by 7.

So if you were to multiply 73684 by 7, add a Cypher thereto, and it is 736840; the half of this number is 368420, which being added to 147368, the double of the given number, the ſumm will be 515788, which is the product of the given number 73684, being multiplied by 7: as here appeareth.

147368 the double of the given number.
368420 half the given number, a Cypher added.
515788 the product, being multiplied by 7

VII. *To Multiply any Number by* 8.

Double the Number given, and ſubſtract that doubled number from the given number, a Cypher being added thereto.

So if you were to multiply 73684 by 8, the double of the given number is 147368; this being ſubſtracted from 736540, (which is the given number with a Cypher added) the remainer

mainer will be 589472, which is the product of the given number 73684, being multiplied by 8; as here appears.

(pher added.
736840 number given, with a Cy.
147368 double of the given number.

589472 product multiplied by 8.

VIII. *To Multiply any Number by 9.*

Add a Cypher to the given Number, and from that number subſtract the given number, the remainer ſhall be the product.

So if you were to multiply 73684 by 9, add a Cypher to it, and it will be 736840; from which if you ſubſtract 73684, your given number, the remainer will be 663156; which is the product of the given number multiplied by 9: As here appeareth.

736840 given number with a Cypher.
73684 the given number ſubſtracted

663156 Product multiplied by 9.

IX. To

IX. *To Multiply any Number by* 10.

Add a Cypher to the given number, and the Work is done.

So 4327 multiplied by 10, is 43270

X. *To Multiply any Number by* 11.

Remove the number given to the left hand one place, and add both together for the product.

So if you were to multiply 3762 by 11, set them thus:

	3762
add both numbers together,	
and the product will be	41382

XI. *To Multiply any number by* 12, 13, 14, 15, 16, 17, 18, or 19.

Multiply 786 by 12

Set the Numbers thus: then say, two times 6 is 12, set down 2 and keep 1 in your mind; then two times 8 is 16, and 1 in mind is 17, and 8 over 1 is 23, set down 3 and carry two tens. Next say, two times 7 is 14, and 2 carried is 16, and 8 over 1 is 24, set down

	786
	12
	9432

down 4 and carry 2, which added to the last figure 7 it makes 9, which set down, so is the product 9432.

And so
468 }
14 } will be 6552

6552

365 }
18 } will be 6570

6570

Compendium 5.

How readily to know how many Pounds are contained in any number of Shillings, without writing them down, or troubling the Memory.

CONceive the last figure of the number given to be taken away, or cut off with a dash of the Pen; then the half of the other part of the number are pounds; and if 1 remain, that 1 is 10*s.* and the figure cut off (or supposed to be cut off) are shillings also.

Example.

Example.

In 624‖7 *Shillings, how many Pounds?*

Suppoſe the 7 to be cut off; then the half of 6 is 3, ſet down 3; the half of 4 is 2, ſet down 2; the half of 2 is 1, ſet down 1: ſo is there in 6427 ſhillings, 321 *l.* 7 *s.*

642‖7 Shillings
Pounds 321-7 Shillings.

In 579‖8 *Shillings, how many Pounds?*

Suppoſe the 8 to be cut off, then ſay, The half of 5 is 2 and 1 remaining, ſet down 2 and carry 1; then ſay, The half of 17 is 8, and 1 remaining, ſet down 8 and carry 1; then ſay, the half of 19 is 9, and 1 remaining, ſet down 9, which being your laſt figure, the 1 remaining is 10*s.* which you muſt add to the 8 that was cut off, and it makes 18 *s.* So that in 5798 ſhillings there are

289 *l.*

289 *l.*-18 *s.* As here appeareth.

22(1 *s.*
5791 8 shillings.
289 pounds 18 *s.*

If you would turn Pounds at one work into Pence, then multiply the Pounds by 240, and the product is Pence.

So 235 *l.* being multiplied by 240, produceth 56300 pence;

On the contrary, to bring Pence into Pounds at one work, divide the Pence by 240, and the Quotient will be Pounds.

So 56300 pence being divided by 240, produceth in the Quotient 235 *l.*

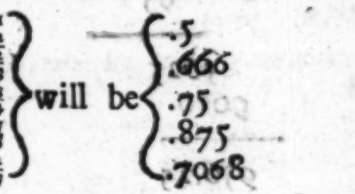
Compendium 6.

How to turn any common Fraction into a decimal Fraction.

ADd Cyphers as many as you pleaſe to the Numerator of the Fraction, and divide the ſumm by the Denominator, the Quotient ſhall be a decimal Fraction equal to the vulgar Fraction.

Let

Let $\frac{3}{4}$ be to be reduced into a decimal Fraction, to 3 add 2, 3, or more Cyphers, and divide that by 4, so shall the Quotient be 75, which must be written thus .75 with a point before it; and that is the decimal Fraction of $\frac{3}{4}$. Likewise the decimal Fraction of



And so of any other.

Compendium 7.

When any Question is propounded in the Rule *of* Three, *where Halves, Quarters, or three Quarters, of Weight or Measure are in the Question, or where Nine-pences, Six-pences, or Three-pences, are ingredients, how you shall resolve such Questions without the help of Fractions, or reducing of your Money, Weight, Measure, to their least Denomination.*

YOu must here suppose your Mony, Weight, or Measure, the Integer, to be divided into 100 parts; which being

being presupposed, the 25 is a Quarter, 50 is Half, and 75 is three Quaters, of any Money, Weight, or Measure.

This presupposed, will proceed to to *Example.* 1.

If 3 yards of any thing cost 1 s. 3 d. what will 85 yards cost?

3 —— 11.25 —— 85

85

5625

9000

956.25

l.	*s.*	*d*
15	18	9

221

95625 (318.75

33333

Here instead of 11 *s.*–3 *d.* I set down 11.25, the 11 signifying 11 *s.* and the 25 3 *d.* which is the quarter of a shilling: and then I multiply and divide, as if it were all whole numbers. For multiplying 11.25 by 85, the product is 956.25: the 25 at the end separated by a prick: is the fraction of a quarter. This number divided by 3, the Quotient is 318.75, that is, 318 *s.* and 75, that is three quarters of a shilling, or 9 *d.* So that if 3 yards cost 11 *s.*–3 *d.*

85 yards

85 yards will coſt 318 *s.* and 9 *d.* which is 15 l.– 18 *s.*–9 *d.*

Example 2.

If 6½ *Ells of any Commodities coſt* 12 l. 15 s. *what ſhall* 37¼ *Ells coſt?*

Set your Numbers thus:

Ells.	*l.*		*Ells.*
If 6. 50	12.75	*what*	37.25
			12.75
			18625
			26075
			7450
			3725
22 4			
5947			
47493 75 (73.06			4749375.
655550			
666			

Here inſtead of 6 Ells and ½, I ſet down 6.50,50 being the half of 100. Again, for 12 *l*–15 *s.* I ſet down 12.75.75 being three quarters of 100, as 15 s. is ¾ of a pound. And laſtly, for 37. Ells and a quarter, I ſet down 37. 25, 25. being one quarter of 100.

And then multiplying and dividing of these as whole numbers, according to the nature of working the *Rule of Three*, I find my quotient to come out 73. 06, that is 73 *l.* $\frac{06}{100}$ parts of a pound, or 20 *s.* which reduced, is 1*s.*–2 *d.*–1 *q.* $\frac{6}{10}$ of a farthing. So that if $6\frac{1}{2}$ Ells cost 12 *l.* 15 *s.* 37 $\frac{1}{4}$ Ells will cost 73 *l.*–1 *s.*–2 *d.*–1 *q* $\frac{6}{10}$.

THE

THE RULE OF *Ceres & Virginum.*

This is the moſt uncertain and unneceſſary Rule in *Arithmetick*, being ſeldom uſed, except in ſporting Queſtions, to puzzle young beginners with eaſie Problems, ſuch as here follow.

QUEST. I.

A Caterer bought 8 Birds of two ſorts, as Geeſe and Hens for 20 s. the Geeſe coſt 4 s. a piece, and the Hens 2 s. a piece, How many did he buy of each ſort?

THis may be done by the Rule of Falſe; and alſo thus: multiply the whole number 8, into the leaſt price 2, it produceth 16, which taken

from the whole price 20, reſts 4 for a Dividend; which divided by 2, which is the difference of the particular prices, the quotient is 2, for the number of *Geeſe*; and 6 muſt be for the *Hens*; the proof is eaſie.

QUEST. II.

If 21 Perſons, Men, Women, and Children ſpend 26 ſhillings; ſo that every Man pays 2 s. every Woman *1 s. every* Child *6 d. How many is there of each ſort.*

To anſwer this Queſtion, this is the

RULE.

Multiply the number of Perſons by the leaſt expence, and take the product of it from the whole expence, the reſt ſhall be the Dividend; which divided by the difference betwixt the greateſt and leaſt particular expences: the quotient is a Number, which the Number of men (or they which ſpend moſt) comes neer to; but cannot exceed; or if the ſaid Dividend be divided by the ſum of the greateſt and leaſt expences, the

the quotient is a Number, then which the Number of men (or those which spend most) cannot be much less.

So here 21 mutiplyed by 6 *d.* that is, by $\frac{1}{2}$, the product is 10 $\frac{1}{2}$, which taken from 26, rests 15 $\frac{1}{2}$, for the Dividend: and then taking $\frac{1}{2}$ from 2, rests 1 $\frac{1}{2}$ for the Divisor, and the quotient is $\frac{31}{3}$, which is something more than 10; the number of Men therefore must be but 9.

Then turn the Dividend, and the Divisor both into whole Numbers, by multiplying them by the common Denominator 2, so they reduced will be 31 and 3, as before is to be seen in the quotient.

Multiply the Divisor 3, by 4 (which is the Number of Men) the product is 27, which taken from 31, (which is the reduced Dividend) the remain is 4, for the Number of Women; and the Children must be 8.

Example 1.

9 Men at 2 *s.* each	18 *s.*	
4 Women at 1 *s.* each	4	
8 Children at 6 *d.* each	4	
In all 21	In all 26	

But the Number of men may be also 8, which multiplied by the reduced Divisor 3, product is 24, which taken from 31, the remain is 7 for the Women; and then the Children must be 6.

Example 2.

8	Men at 2 *s.* each	16
7	Women at 1 *s.* each	7
6	Children at 6 *d.* each	3
In all 21		In all 26

Or the Number of men may be 7, which multiplyed by 3. produceth 21, which taken from 31. remains 10 for the Women, and 4 Children.

Example 3.

7	Men at 2 *s.* each	14 *s.*
10	Women at 1 *s.* each	10
4	Children at 6 *d.* each	2
In all 21		In all 26

So is already seen 3 various solutions of this question, which makes this Rule

Rule the leſs to be regarded. But further, the number of Men may be 10, and not more, for if you put them 11, that multiplyed by 3, produceth 33, which is greater than 31, from which it ſhould be taken, but I ſay it may be 10, and then there is only one Woman, and five Children: this confirms the former part of the Rule.

Now for the latter part, if the Dividend 31, be divided by the ſum of the two extream expences (reduced by doubling, as the Dividend is) 4, the quotient will be $7\frac{3}{4}$. And the Men may be 7, as hath been ſhewed; but they may be alſo but 6, and fewer they cannot be: as 6 Men, 13 Women and 2 Children; for if you put them 5, that multiplyed by 3, produceth 15, which taken from 31, there remains 16 for the Women, and ſo there ſhould be no Children, which is contrary to the ſuppoſition.

And further, becauſe the quotient was $7\frac{3}{4}$, the number of men might be ſo, if pure Arithmetical diviſion be only regarded: and then the Women alſo are in number $7\frac{3}{4}$, and the Chil-

dren $5\frac{1}{3}$, as may easily be tryed; I need not exemplifie it.

Question 3.

If there be an Exhibition of 900 l. per Annum *to* 30 *persons: some Clerks, some Messengers, and some Doorkeepers, at* 6 l. *each Clerk,* 40 l *each Messenger, and* 20 l. *each Door-keeper; how many must there be of each sort?*

Multiply (according to the Rule) 30 by 20, the product is 600, which taken from 900, remains 300 for the Dividend; and 60 want 20, that is 40, for the Divisor: and the Qnotient is $7\frac{1}{2}$, and more the Clerks cannot be: Also divide by 60 more 20, that is 80, quotient is $3\frac{3}{4}$, and much fewer the Clerks cannot be.

Not to stand upon the Fractions (in this case of dividing men) the Clerks may be 7, 6, 5, 4, 3: and the Messengers 1, 3, 5, 7, or 9, and the Doorkeepers 22, 21, 20, 19, or 18, that the Clerks cannot (in whole numbers) be more than 7, or less than 3, may thus be proved: First, let them be

be 8, then 8 times 40 is 320, which is more than 300, out of which it ſhould be taken: Secondly, let them be 2, then 2 times 40 is 80, out of 300 remains 220, which divided by 20, gives the quotient 11, for the Meſſengers; ſo the Clerks and Meſſengers being 13, the remain thereof to 30, namely 17, muſt be Door-keepers.

but,

2 Clerks at 60 *l.* each	120 *l.*
11 Meſſengers at 40 *l.* each	480
17 Doorkeepers at 20 *l.* each	340
In all 30	In all 940

Which is 40 *l.* too much, therefore the Clerks cannot be two.

Note,

It may be asked, *Why the remain 220 ſhould be divided by 20: whereas the like remain in the former Example, namely, 16, was taken (without any diviſion) abſolutely for the number of Women, or middle number?* I anſwer, altho the greateſt or firſt Number being found, (as here to be 2) the reſidue of

2 to 30, might be rightly parted into two fit parts in the same manner as the first question of this Rule was resolved, or else by the Rule of False: yet to give further satisfaction, the cause of this is, the difference betwixt the two lesser expences, was there 1 which (before the division was reduced to 1, which neither multiplies nor divides any Number, but leaves it the same: whereas, in this last, the middle expence (or exhibition) being 40 and the least 20, the difference of them was 20, by which dividing the Remain of the last subtraction: the quotient is ever the Number of the middle persons. Which may serve for an addition to the Rule, where three sorts of things are but there.

Question 4.

If there be 10 *persons of four several Countries*, English, French, Dutch and Spanish, *to pay a Debt of* 1000 l. *that every English Man payes* 50 l. *every French Man* 70 l. *every Dutch Man* 130 l. *and every Spaniard* 150 l. *How many is there of each?*

The

The Dividend (according to the former Rule) is 500.

Now to make the Diviſor, take his ſum that pays leaſt (namely 50) out of each of the other three 150 130, and 70, and the Remains will be, 100, 80, and 20.

Add the firſt and leaſt for the Diviſor, it is 120.

And the Quotient will be $4\frac{5}{12}$, and the Spaniards cannot be more.

Secondly, add the firſt and ſecond together for the Diviſor, it is 180, and the quotient is $2\frac{1}{18}$, and the Spaniards cannot be leſs.

I mean, they cannot be much more than 4, or leſs than 2: and therefore, ſeeing any one ſolution will ſerve, let them be 3, and by that multiply 100, and take the product out of 500, there remains 200 for a ſecond Dividend, which divided by (the ſecond remain) 80, the quotient is $2\frac{1}{2}$: therefore Dutchmen are 2; which multiplied by 80, make 160, take that out of 200, there remains 40 for a third Dividend: which divided by (the third remain) 20, the quotient is 2 for the French Men alſo;

and

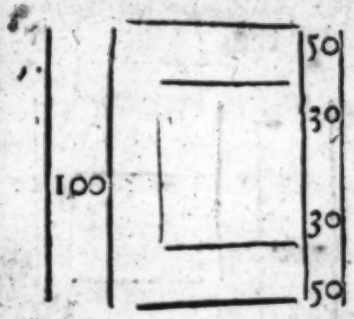
and consequently the English must be 3, because all of them are 10: But the Spaniards may be also 4 or 2.

Example.

4	Spaniards at 150 *l.* each	600
1	Dutchman at 230 *l.*	130
1	Frenchman at 70 *l.*	70
4	English at 50 *l.* each	200
10	In all	1000
2	Spaniards at 150 *l.* each	300
3	Dutch at 130 *l.* each	390
3	French at 70 *l.* each	210
2	English at 50 *l.* each	100
10	In all	1000

The reason why the Spaniards and English, as also the Dutch and French are equal in number, is because their payments differ equally from 100, which is the mean summ with which 10 men should pay 1000 *l.* and making it so, this question, and many other of this nature, may be answered by the Rule of *Alligation*; thus,

If



If 160 give 10, what 50? anſwer is 10 $3\frac{19}{160}$ (that is in this caſe 3) for the *Spaniards*, and as many for the Engliſh, becauſe their reſpective differences from 100, the one 50 more; the Engliſh 50 leſs, are equal.

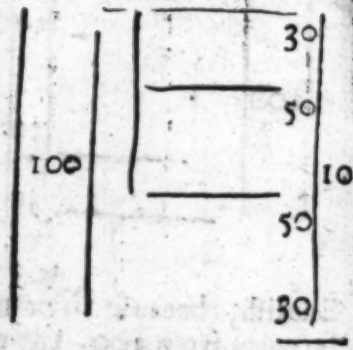
And alſo, becauſe the other two differences 30 and 30 are equal; the Number of the *French* is equal to the number of the *Dutch*.

But both thoſe numbers together are 4, becauſe 3 Spaniards, and 3 Engliſh, taken out of 10, the main muſt be 4.

Wherefore the number of the French is 2, and the Dutch alſo are 2.

Or

Or thus:



Accounting the men in the same order, as before.

If 160 require 10, what 30?

Answer is $1\frac{160}{160}$ (that is, in this case 2) for the *Sapniards*, and consequently 2 *English*; and therefore the *French* and *Dutch* each 3.

But where any one of the particular summs is equal to the mean summ, there this cannot so well be done by *Alligation*.

Example.

If one should buy 12 *Loaves of Bread for* 12 pence, *so that some might be* two penny, *some* penny, *some* half-penny, *and some* farthing *Loaves: and it be required to know how many he must buy of each?*

Then

Then becauſe of 12 *Loaves* for 12 pence, the mean price is 1, but one of the particulars being alſo 1, there ſhould be no penny loaves, becauſe there is no difference betwixt the mean *price*, und a *penny*.

But it may be found by the Rule of *Ceres* and *Virginum* to be either.

4	Two penny loaves	8 pence
2	Penny loaves	2 pence
2	Half-penny loaves	1 penny
4	Farthings loaves	1 penny
In all 12 loaves.		In all 12 pence.

Or elſe

3	Two penny loaves	6 d.
4	Penny loaves	4
3	Half-penny loaves	1½.
2	Farthing loaves	0½.
In all 12		In all 12

Ex-

Extraction of Roots.

1. *Of the Square Root.*

The SQUARE ROOT *is a Square Number* being given, to find the Root or side of it in a Number which *root* or *side*, being multiplied in to it self, must therefore produce that square Number.

The doing of this is shewed in (almost) all Books of Arithmetick; and the reason of it (in some) which is taken from the fourth Theorem of the second Book of *Enclide*; which saith.

If a right line be divided by chance; the squares made of the parts, together with the Restangle made of the parts twice, is equal to the square of the whole.

Example.

There are Eight Towns (or Villages) which be in a Right Line one from the other; as the Towns A, B, C, D, E, F, G, *and* H, *Now the Distance of the First Town* A, *to the Second Town* B, *is*

is not known; But all the reſt of the Towns are Four Miles diſtant one from the other; and yet, the diſtance of the Town G, from the Town A, muſt be double to the diſtance of the Firſt Town A, to the Second Town B, How far are all the Towns one from the other?

LEt the Seven Towns ſtand in order as in the following Figure, And for the diſtance of A to B, ſuppoſe any Number of Miles; As 7 Miles: A 7, B 11, C 15, D 19, E 23, F 27, G 31, H:

Then if from A to B be 7 Miles, to C muſt be 11 Miles, to D 15 Miles, to E 19 Miles, *&c.* as in the Figure: But by the *Queſtion*, the laſt diſtance, (which is here 31) ſhould be but 14, for it ſhould be double to the diſtance between A and B, which was ſuppoſed to be 7 Miles: and therefore, the diſtance from A to B was not rightly eſtimated: Yet from hence the true diſtance between A and B may be found; in his manner.

From

From 31, the laſt diſtance, Subſtract 7, the ſuppoſed diſtance between A and B, the remainder will be 24; and that is the true diſtance between A and B; And then will the laſt diſtance 49 be double the firſt diſtance 24. which Anſwers the *Queſtion*; As the Figure following does appear.

A 24 B 28, C 32, D 36, E 40, F 44, G 48, H.

Example. 2.

One took a Sum of Money with him, and went to a Gaming Houſe, where, at his Firſt Game he doubled the Money he brought with him: At his Second Game he loſt, 120 l. *At the Third Game he doubled the Money he had remaining: At the Fourth Game he loſt* 120 l. *and had no Money left. What was the Summ of Money that he took with him?*

FOrasmuch as he loſt 120 *l.* at the Fourth Games End, and had then no Money left, it is evident that he had but 120 *l.* at the end of the Third Game, which was the double

ble of the Money which he had at the end of the Second Game, namely, 60 *l.* which with 120 *l.* which he loſt at the end of the Second Game, makes 180 *l.* which was the double of the Money which he brought with him, namely 90 *l.* Which I thus prove.

	l.
The Money brought with him—	90
The Firſt Game doubled it——	180
The Second Game he loſt——	120
Then had he left—— ——	60
At the Third Game he doubled it	120
At the Fourth Game he loſt——	120
Remains——	000

Example 3.

There are Two Ladders, in both which there are 40 *Rounds or Steps, and for every Two Steps in one of the Ladders there are* 3 *in the other; how many Steps is there in each Ladder?*

ADd 2 and 3 together, they make 5, Then, ſay by the Common Rule of Three,

As

As 5 Steps is to 40 Steps: So is 3 Steps to 24 Steps for the Longeſt Ladder. Then again.

As 5 Steps is to 40 Steps, So is 2 Steps to 16 Steps.

Or,

Multiply 40 by 2 and by 3, and the Product will be 80 and 120: both which Numbers divide by 5, and the two Quotients will be 16 and 24 for the Number of Rounds in each Ladder, which together make 40.

Example 4.

There are two Veſſels, which together hold 52 *Gallons, and one of the Veſſels holds nine Gallons more then the other. How many Gallons do each Veſſel hold?*

TO 52 the Summ of the Gallons, add 9 the difference of Gallons which each Veſſel holdeth; the Summ whereof will be 61 Gallons, the half whereof is 30 Gallons and a half, And ſo much doth the Greater Veſſel hold, from which Subſtract 9 (the diffe-

difference) and the remainder will be 21 Gallons and a half; and ſo many Gallons will the Leſſer Veſſel hold: For 21 Gallons and a half, and 30 Gallons and a half make 52 Gallons, and Anſwers the Queſtion.

Example 5.

A Butcher at a Country Fair, bought a Bullock which coſt him a certain Number of Crowns, and afterwards he bought 5 Bullocks more, and each Bullock after the Firſt, exceeded the Price of that which he bought before by Three Crowns, and the Price of the Sixth Bullock was juſt double to the Price of the Firſt. What did the Firſt Bullock coſt, and conſequently every of the other?

SUppoſe that the Firſt Bullock coſt him 5 Crowns; then, the Second coſt him 8 Crowns; the third 11 Crowns; the Fourth 14 Crowns; the Fifth 17 Crowns, and the Sixth 20 Crowns, which (by the Queſtion) would be but double to the Price of the Firſt, namely 10 Cowns, therefore

fore your ſuppoſition of 5 Crowns for the Firſt Bullock was not right: But, by this Suppoſition, the true Price of the Firſt Bullock may be found; for if from 20 Crowns, (the Price of the Sixth Bullock) the remainder will be 15 Crowns, for the Price of the Firſt Bullock, Then will the Second Bullock coſt him 18 Crowns; the third 21 Crowns; the Fourth 24 Crowns, the Fifth 27 Crowns, and the Sixth 30 Crowns; juſt double to 15 Crowns the Price of the Firſt Bullock, and Anſwers the Queſtion.

Example 6.

There are Six Veſſels, which together hold Six Hundred Gallons, and the Second Veſſel holds Three Gallons more than the Firſt, the Third, Three Gallons more than the Second, and ſo to the laſt: The Queſtion is, How many Gallons doth the leaſt Veſſel hold, and conſequently all the other Five?

LEt the Six Veſſels be repreſented by the Six Letters A B C D E F: Now ſuppoſe the Firſt (or the leaſt) Veſſel

Veſſel A to hold One Gallon, then the Second muſt hold 1 and 3 more, the third muſt hold 1 and 6 more and ſo the reſt as in the Table following.

A	holds	1	Gallon.
B	holds	1	and 3
C	holds	1	and 6
D	holds	1	and 9
E	holds	1	and 12
F	holds	1	and 15
		6	and 45

By this Table it appears, that if the Leaſt Veſſel hold but one Gallon, the greateſt ſhould hold but 16 Gallons, and the Summ of the Contents of all the Veſſels is but 45 Gallons, which ſhould be 600, wherefore your Suppoſition for your firſt Veſſel A was too little, but if from 600, you ſubſtract 45, the remainder will be 555, which divided by 6 (the Number of Veſſels) the Quotient will be 92 Gallons and an half; and ſo much muſt the Leaſt Veſſel hold: which is thus proved:

If

If	A	Contains	92 . 5
	B		95 . 5
	C		98 . 5
	D		101 . 5
	E		104 . 5
	F		107 . 5
		The Sum	600 . 0

For if A holds 92 and a half, B must contain 3 more, yet is 95 and a half: C 98 and a half; and the rest as in the Table; the Sum of all which is 600 Gallons, and Answers the Question.

Example 7.

What Number is that, which being divided by 2, 3, 4, 5, or 6, there shall still remain One, but being divided by 7, there shall nothing remain.

Multiply 2, 3, 4 5, 6, One into another, and they make 720, to which add 1, and it makes 721, which Number being divided by 2, 3, 4, 5,

4, 5, or 6, there will ſtill remain One, but being divided by 7, nothing will remain.

Example 8.

There are Seven Towns or Villages, lying in a Right Line one from the other, as A B C D E F G. *Now the diſtance from* A *to* B (*the Firſt Town from the Second*) *is unknown, but all the reſt are diſtant one from the other four Miles, and yet the diſtance between the two laſt* (*from* F *to* G,) *is double to the diſtance of the Firſt from the Second, as of* A *from* B.

Let the Seven Towns ſtand in this Figure,

A B C D E F G,

Now ſuppoſe the diſtance from A to B to be any Number of Miles whatſoever; as 7.

Then if from A to B be 7 Miles, then

From { A to C is 11 / A to D is 15 / A to E is 19 / A to F is 23 / A to G is 27

But by the Question, the distance between F and G (*viz.* 27) should be double to the distance between A and B, which should but be 14 Miles, & therefore the distance from A to B was not rightly Estimated: But from hence the true distance from A to B may be form'd. For, if from 27, the last distance, as of A from G, you substract the supposed Number 7, the Remainder will be 20: and so far must be the point for the distance of the Town A, from the Town B: and then, the distance from A to G will be found to be 40 Miles; which is double to the distance between A and B, 20 Miles: and Answers the Question. As,

From

From A to { B — 20, C — 24, D — 28, E — 32, F — 36, G — 40 } Miles.

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